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Conceptual Design Report New Hydrofracture Facility

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H. O. Weeren

OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION • FOR THE U.S. ATOMIC ENERGY COMMISSION

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OPERATIONS DIVISION

CONCEPTUAL DESIGN REPORT

NEW HYDROFRACTURE FACILITY

R. E. Lampton
R. A. Robinson
H. O. Weeren

JULY 1975

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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NEW HYDROFRACTURE FACILITY

R. E. Lampton, R. A. Robinson, H. O. Weeren

1.0 INTRODUCTION

This report presents the results of a conceptual design study for a proposed New Hydrofracture Waste Disposal Facility at the Holifield National Laboratory. Development of the shale fracturing process began at the Holifield National Laboratory in 1959, and it has been used for the routine disposal of intermediate level liquid radioactive waste (ILW) since 1966. In this process, waste solutions generated in the course of various Laboratory programs are collected and concentrated in an evaporator and then are mixed with cement and other additives to form a thin grout. The grout is injected into an impermeable shale formation at a depth of about 1000 ft, well below the depth of the bottom of the water table in this area. Injection pressures of several thousands lbs per sq in. induce horizontal fractures in the shale formation, and the grout spreads out in the form of a thin sheet along the bedding plans of the shale. Shortly after completion of the injection, the grout sets, thereby permanently fixing the radioactive wastes within the shale structure. Subsequent injections are made at about 10 ft intervals in the shale formation and form grout sheets that are approximately parallel to the preceding sheets. Typically, the activity concentration of the injected waste ranges from 0.2 to 2.0 Ci/gal.

The presently used facility (Fig. 1) was built as an experimental research facility during the development of the process. It was not originally intended for routine operating use. Much of the usable shale formation underlying the site was used up during the development program. It is estimated that the present injection well has a capacity for about five more years of operation at current waste generation rates at HNL. The proposed new facility is expected to provide capacity for the disposal of intermediate level waste at the Holifield National Laboratory for the next thirty years assuming that waste generation rates remain at about the present level. In addition, there will be sufficient capacity to dispose of approximately thirty years accumulation of waste sludges (350,000 gal) that have been deposited in the waste collection and storage tanks at HNL.

ORNL-DWG 63-3830

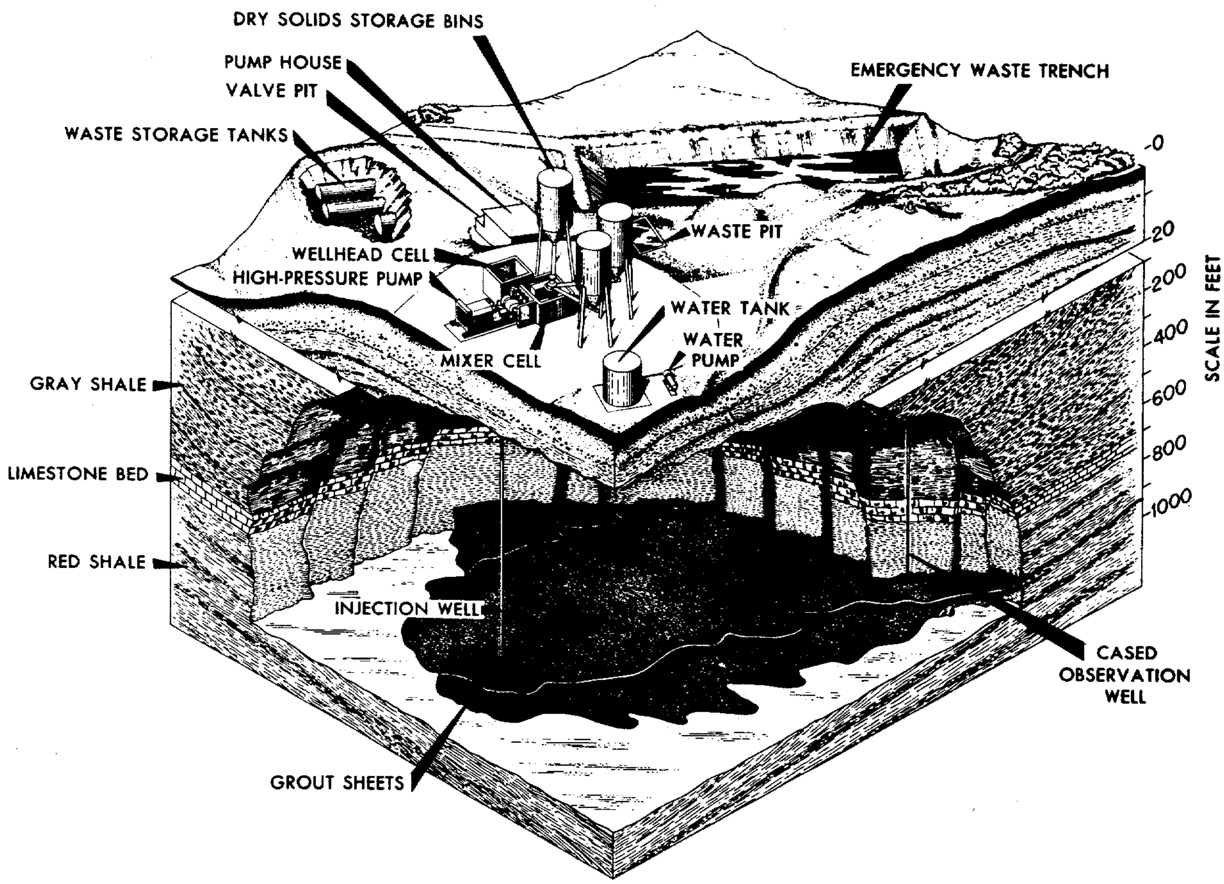


Figure 1. ORNL Fracturing Disposal Pilot Plant

since the early 1940's. These sludges, which contain most of the uranium, strontium, and transuranium nuclides in the incoming waste stream, result from the neutralization of the raw waste prior to evaporation.

A FY-1975 construction project (ILW Management Facilities) related to this proposed project will provide, among other things, new waste collection storage tanks and a pipeline for transfer of concentrated waste from the evaporator facility to the new waste storage tanks. These new storage tanks have been located in the close proximity to the proposed site for the New Hydrofracture Facility and will serve as the feed tanks for the new facility.

2.0 DESCRIPTION OF PROJECT

2.1 General

This project includes the following components:

(1) A new hydrofracture operations building, containing approximately 5800 sq ft of floor area.

(2) Four observation wells drilled to a depth of approximately 1200 ft and cased the full length.

(3) Eight rock cover wells drilled to a depth of 600-700 ft and cased to a depth of 500-600 ft.

(4) A system of bench marks extending a distance of 2000 ft from the injection well to the south, east, and west directions.

(5) Extension of utility systems to the new site including air, water, and electric power.

(6) Underground, doubly contained stainless steel pipelines for transfer of waste from the new storage tanks provided as part of a FY-75 project to the New Hydrofracture Facility.

(7) Site clearing and grading, and access road improvements.

(8) Equipment to blend and store cement mix solids and to mix the solids with the waste stream, inject the waste grout into the well, and to monitor and control the operation.

Four observation wells, in addition to the four noted above, and the new waste injection well which will serve the new facility were drilled and cased as part of a site proof study (Section 2.3) in FY-74 and are not included as part of the funding for this project. Each of these components is discussed in more detail in the following sections of this report. The facilities and equipment included in this project will provide a complete system for the hydrofracture disposal of intermediate level radioactive waste at the Holifield National Laboratory.

2.2 The Hydrofracture Process

The hydraulic fracturing process has been widely used in the petroleum industry for a number of years to improve the recovery of oil from wells. It has also been used by the chemical and petroleum industries and other types of manufacturing operations to dispose of particularly troublesome types of chemical wastes. The disposal of radioactive wastes in impermeable shale by hydraulic fracturing is a technique that has never been used except at the Holifield National Laboratory. In the case of ordinary chemical wastes, hydrofracture disposal is normally carried out in permeable rock formations. The liquid is forced into the fracture in the permeable rock and into the pore structure where it becomes trapped and remains as liquid. However, in the case of radioactive liquids at the Holifield National Laboratory, a highly impermeable shale formation is used, and the waste is combined with additives so that after it flows out into the shale structure, it solidifies and becomes a part of the shale. This procedure for solidifying the waste within the shale structure provides added assurance that the radioactive constituents will not, at any future date, migrate back into man's environment. A further requirement for the safe use of the hydrofracture technique for the disposal of radioactive wastes is assurance that the hydraulically induced fractures, and therefore the waste-grout sheet, will move out in a generally horizontal direction from the injection well and will not turn and travel up towards the earth's surface. A portion of the Holifield National Laboratory is underlain by thick shale formations that are ideally suited for this type of hydrofracture disposal. The upper portion of this shale formation consists of about 600 to 700 ft of a high integrity non-fractured dense gray shale. This is underlain by about 300 ft of red shale which is composed of thin, horizontally oriented beds. The red shale fractures easily and preferentially along the bedding planes. Disposal operations are carried out in the red shale formation in the depth interval from about 750 to 1000 ft below the surface of the ground. The overlying gray shale formation provides a highly impermeable barrier to prevent the migration of ground water down to the disposal zone. This insures that the solidified implanted waste will remain permanently isolated from the biosphere.

As noted previously, radioactive liquid wastes at the Holifield National Laboratory are collected at a central facility, neutralized, and fed to an evaporator which concentrates them by a factor of 25 to 30. The concentrate is accumulated until a sufficient volume is on hand to warrant the disposal operation. This is usually in the range of 80,000 to 100,000 gallons. At this time solids consisting of cement, fly ash, attapulgite, and grundite are blended in pneumatic blending tanks at the hydrofracture site. The blended solids are then pneumatically transferred to large solid storage tanks from which they can be pneumatically fed to the process during hydrofracture injection. Prior to the start of the waste injection, the injection well casing is first slotted and then a fracture is induced in the underlying shale formation. Slotting is accomplished by pumping a sand-water mixture thru a tubing string and jet at high pressure at the bottom of the well which erodes the well casing and the surrounding casing cement. The well is then pressurized with water until the fracture is initiated. Fracturing normally occurs at a pressure of about 2500 to 3500 psi. After the initial fracture has been induced, waste is pumped into a jet mixer within the facility where it is continuously combined with the solids pneumatically conveyed from the solids storage tanks. A mass flowmeter is used to control the solids flow to obtain the desired mix ratio. The mixed grout then flows into a mixing tub which serves as a deaerator and as a feed tank for the injection pump. The waste grout mix flows from the mix tub to the suction side of the 400 hp positive displacement injection pump and then thru a tubing string down into the injection well and out into the slot in the well casing. As the waste flows out into the fracture, the fracture propagates ahead of it, and the grout spreads out in a thin sheet from the well. A retardant added to the grout slows down the setting time so that is remains fluid for a period of about twelve hours. The injection of the grout is normally carried out at a rate of about 200 to 300 gal per minute, and at a pressure of 2000 to 3000 psi. Approximately 800,000 lbs of cement mix solids are needed for each 100,000 gal of waste concentrate that is injected. Up to four injections may be made in each slot. Subsequent injections are made by re-slotting the well at about 10 ft intervals. A schematic flow diagram of the process is shown in Fig. 2.

Eight observation wells located at various distances out to 400 ft from the injection well are used to determine the orientation of the grout sheet after each injection. Gamma probes are lowered down these wells and the grout sheet is located by the radiation emanating from the implanted wastes. In addition, eight rock cover wells are used to periodically test the cover rock (gray shale) for fractures that may have been induced by the hydrofracture in the underlying formation. These wells, drilled to a depth of 600 ft have the lower 100 ft uncased. The wells are filled with water and held under pressure for several hours. The rate of pressure drop during this period will indicate the presence of fractures if they have formed as a result of the injection operations. Fig. 3 is a schematic of the three types of wells used.

2.3 The Hydrofracture Site

The main operating area of the Holifield National Laboratory is located in Bethel Valley in the south central part of the Oak Ridge ERDA reservation. Certain Laboratory operations, including the existing Shale Fracturing Facility, are located in Melton Valley which is about a mile to the southeast of the main operating area. The proposed location for the New Hydrofracture Facility is located about 800 ft southwest of the existing facility. Because of its close proximity to the existing facility, it was expected that the underground strata would be similar at the proposed new site to that at the existing facility, and that it would be suitable for hydrofracture disposal operations. To verify that the proposed site was suitable, a site proof study was undertaken during FY-74 which consisted of drilling an injection well and four monitoring wells, and making a test injection of a synthetic grout tagged with radioisotope tracer. In addition, one of the wells that was drilled was cored in the depth interval between 700 and 1100 ft for comparison with the geologic structure that was obtained from similar cores at the existing site.

ORNL DWG 73-3976

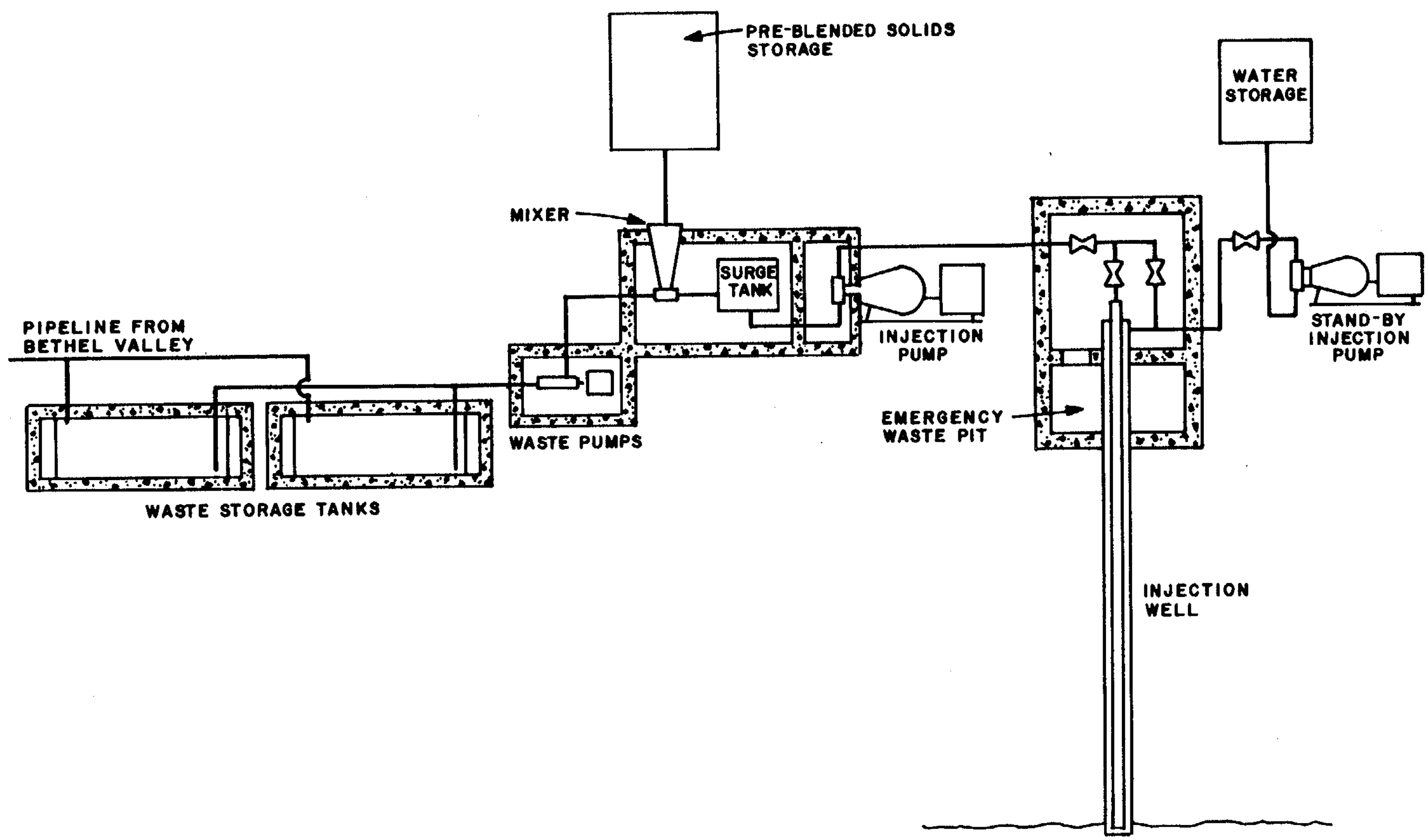


Figure 2. Flow Diagram of New Shale Fracturing Facility

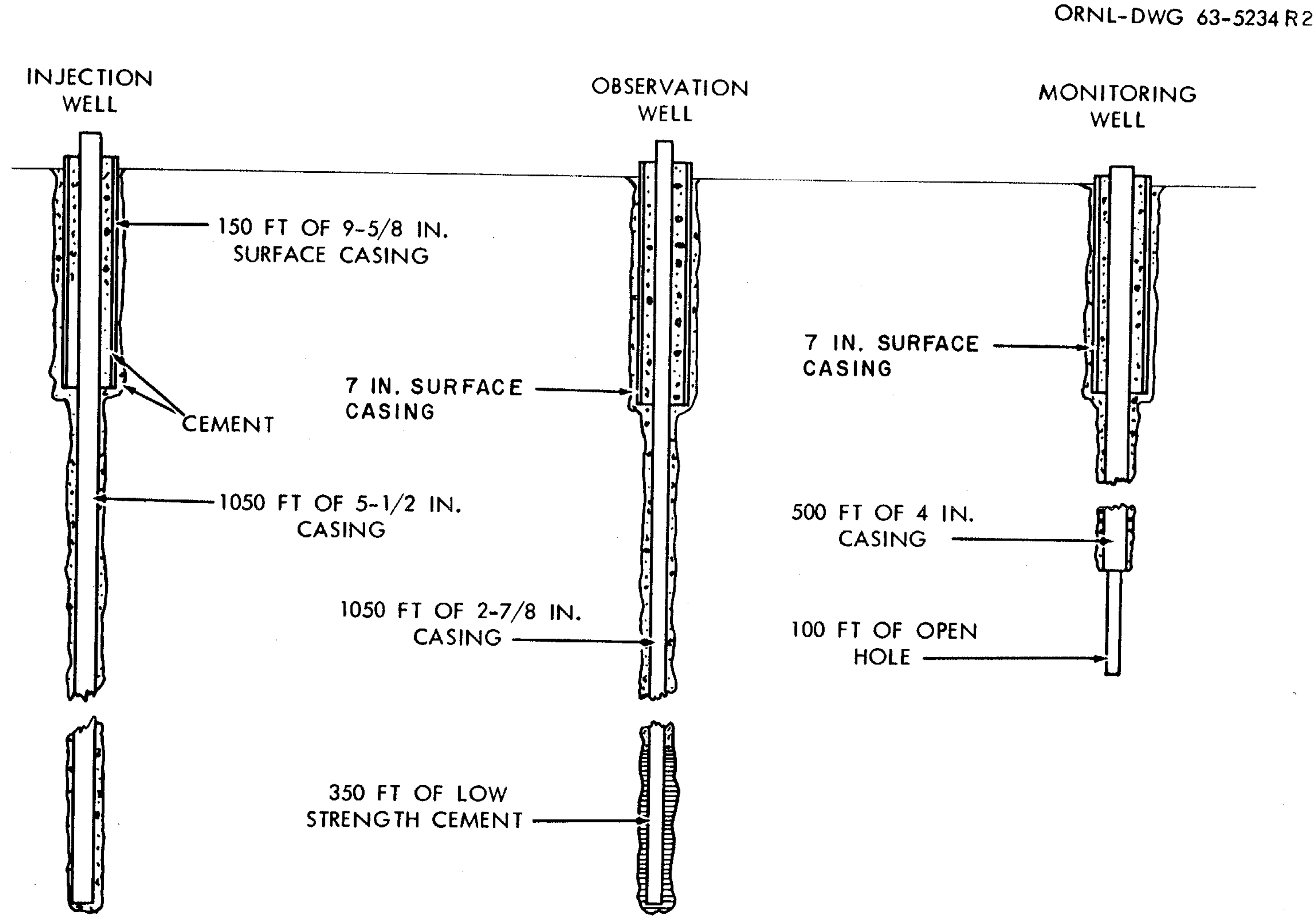


Figure 3. Sketch of Wells for Fracturing Experiment

These core samples along with subsequent gamma logging of the monitoring and injection well at the new site show that the stratigraphy is essentially the same as that at the existing hydrofracture site, with the main difference being that the dip of the red shale in the disposal formation is somewhat flatter, 4° to 10° to the southeast, at the new site than it is at the old site.

The four observation wells and the injection well at the new site were drilled using rotary drilling apparatus to a depth of about 1100 ft. The wells all deviate to the northwest as shown in Figs. 4 and 5. However, they form a relatively parallel system and are satisfactory for determining the location of injected grout sheets. Table 1 lists the coordinates of the tops and bottoms of each well and other pertinent data regarding well locations and depths. A temporary line was installed between the injection pump at the existing facility and the new injection well, and the new well was slotted at a depth of about 1090 ft. The red shale formation fractured at a pressure of about 2650 psi and the fracture could be propagated at a pressure of about 2200 psi. The test injection, consisting of about 100,000 gal of grout tagged with 20 curies of gold-198, was made on June 14, 1974. The injection rate averaged 247 gal per minute at an average pressure at the pump of 2900 psi and at the wellhead at about 2400 psi. The average solids content of the injected grout was 8.05 lbs per gal. After the completion of the test injection the four observation wells were logged promptly with a gamma sensitive probe. The grout sheet resulting from the injection was found in the north, south, and west wells. It appeared to have followed the bedding planes as was expected. No evidence of the sheet was found during the logging of the east well. Over 30 ft of the depth of this well was lost when the casing was cemented. As a result, the elevation of the bottom of this well is only 17 ft below the slot that was made in the injection. Considering that this well is down dip from the injection well, it is likely that the fracture probably passed some 18 ft below the lowest point that could be logged in this well. A more detailed description and discussion of the site proof studies can be found in ORNL-TM-4713, "Hydrofracture Site Proof Study at Oak Ridge National Laboratory," October 1974. The results of the study indicate that the proposed site for the New Hydrofracture Facility is suitable for hydrofracture disposal operations.

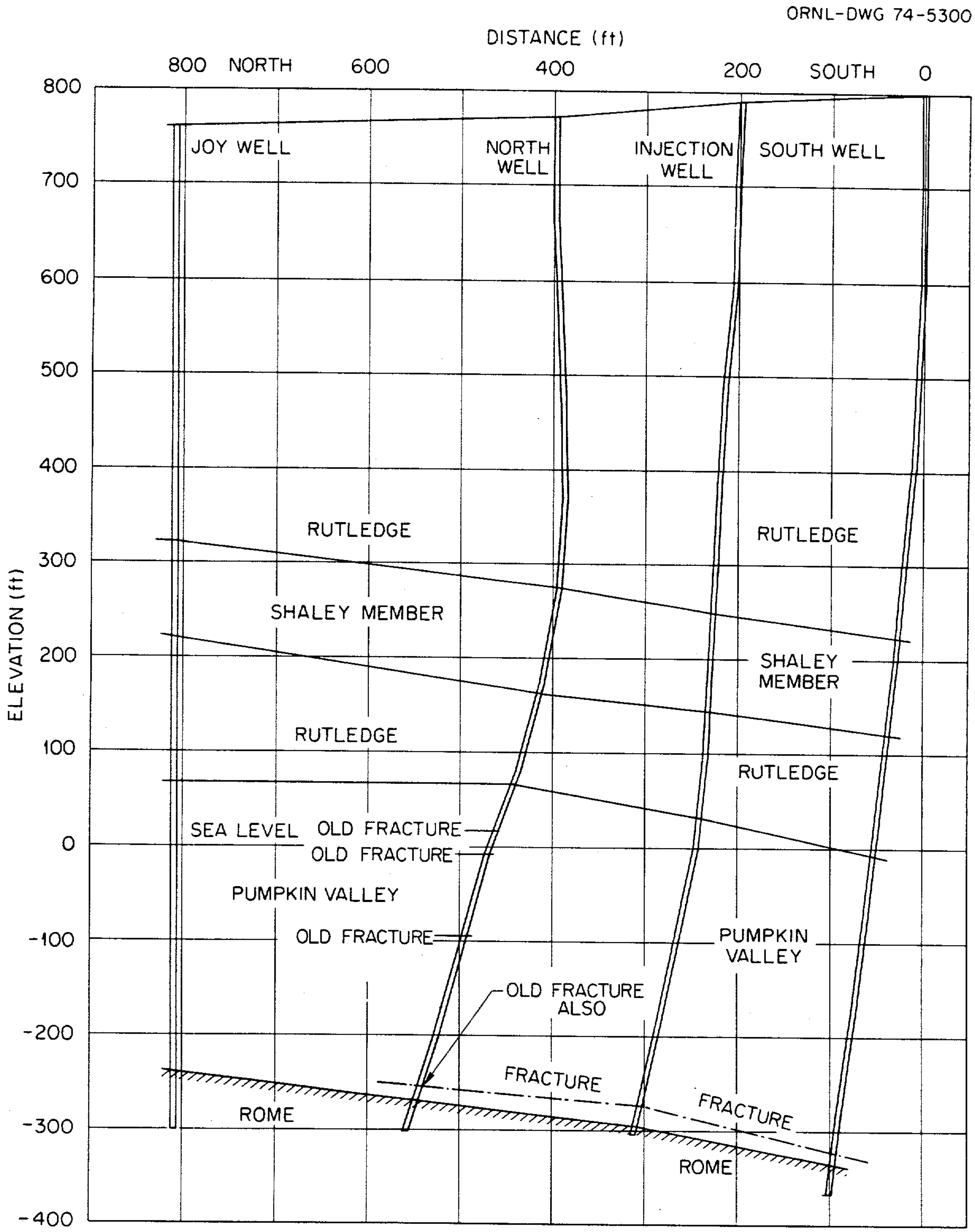


Figure 4. North-South Section at Test Site

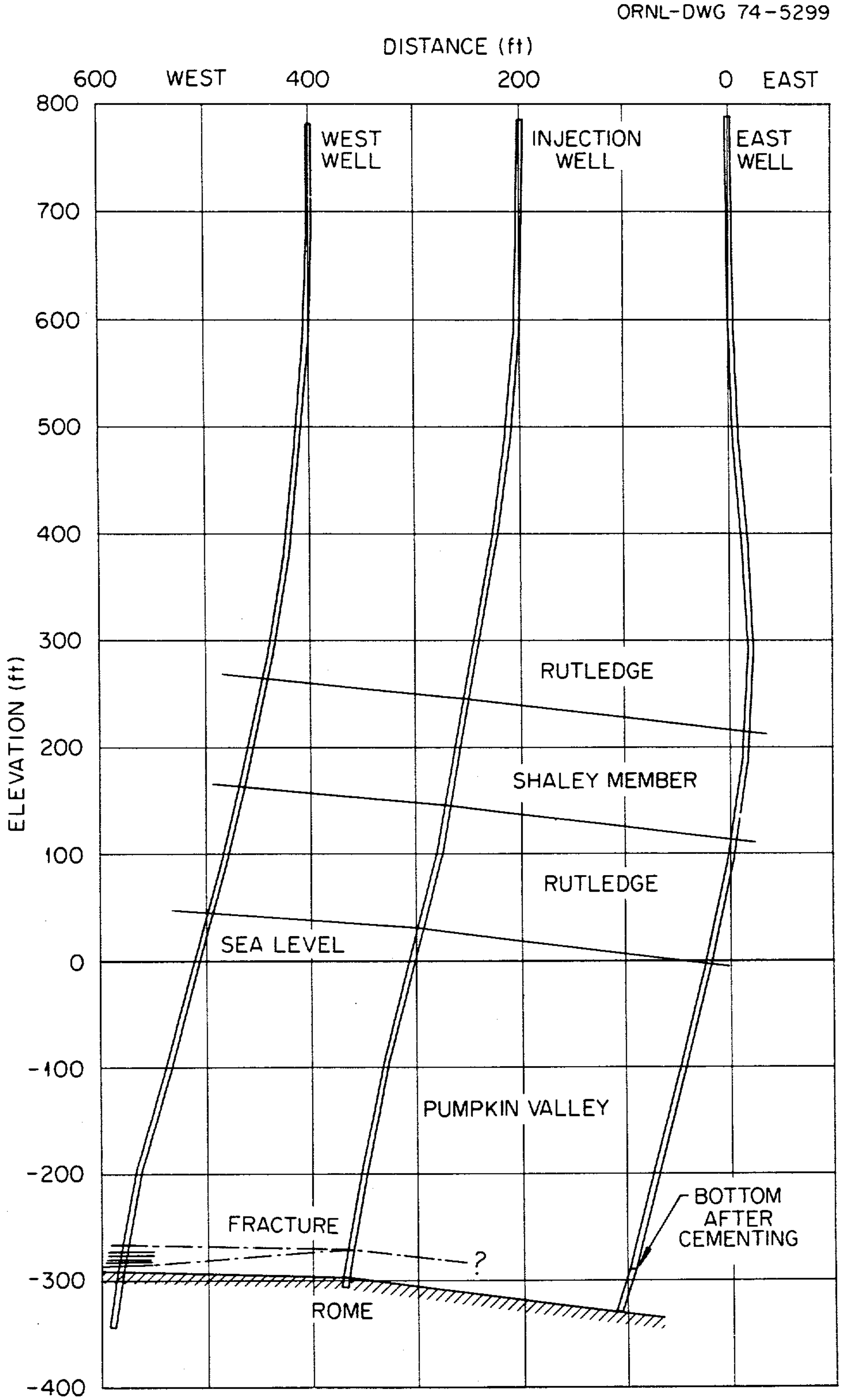


Figure 5. East-West Section at Test Site

Table 1. Statistical Resume of the Wells at the Test Site

	West (ft)	South (ft)	East (ft)	North (ft)	Injection (ft)
Coordinates	N16502.09 E27978.14	N16304.18 E28179.01	N16503.14 E28377.88	N16702.33 E28178.13	N16502.67 E28178.54
Elevation	782.48*	799.12	787.99	771.15	788.91
Length of Hole	1152	1195	1135	1120	1127
Length of Casing	1133	1158	1106	1102	1138
Depth of Hole	1127	1168	1115	1072	1102
Depth of Casing	1107	1131	1086	1051	1087
Coordinates of bottom of casing	N16681.7 E27878.7 -320.6*	N16505.6 E28070.2 -351.5	N16610.8 E28216.3 -306.0	N16935.2 E28143.3 -283.8	N16700.3 N28105.9 -303.9
Elevations of lower limestone	52.4*	-9.3	-7.4	89.7	43.6
Rome sandstone	-288.3*	-334.7	-333.7	-267.7	-298.9
Elevations of bottoms of holes after cementing	-313.7*	-348.6	-303.1	-277.5	-297.5

*Mean sea level.

2.4 Principal Elements of the Project

2.4.1 The Hydrofracture Building

The new hydrofracture building will house a cell bank containing three cells having reinforced concrete walls and ceilings 2 ft thick and related operating and service areas for mixing, storage, and handling of bulk solids used during the operation. The building is of reinforced concrete and masonry construction having overall dimensions of 74 ft long x 68 ft wide. The main roof level is 14 ft above ground level. A high bay section 19 ft wide by 23 ft long, located directly above the injection well, will be used for introducing and removing the injection tubing string and will rise 54 ft above ground level. The facility is designed to dispose of 100,000 gal batches of waste containing up to 20 curies per gal of mixed fission products as frequently as once per month.

2.4.2 Special Facilities

2.4.2.1 Injection Cell

Immediately over the injection well is a cell having interior dimensions of approximately 19 ft by 15 ft by 21 ft high which accommodates the wellhead, the valve manifold to direct flows for injection, slotting, and cleanup operations, and related high pressure piping. All equipment is located in the upper 12 ft of the cell. The space below, approximately 9 ft deep, will be opened to similar spaces below the other cells. These spaces will provide a 47,000 gal storage reservoir to collect grout in the event that there is a wellhead or piping system failure.

2.4.2.2 Pump Cell

The pump cell has interior dimensions of approximately 27 ft by 14 ft by 12 ft high and houses two Halliburton HT-400 triplex pump heads. One pump is used to make the grout injections while the second maintains water pressure on the annulus of the injection well to prevent grout from backing up the well. In addition, the second pump serves as a standby pump to clear the well in the event that the main injection pump should fail. Only the pump heads are inside the shielded cell. The diesel drive motor and all controls are located in a soundproof cubicle at the rear of the cell. Removable unit shielding will be provided to permit direct maintenance on pump heads.

2.4.2.3 Mixing Cell

The mixing cell has interior dimensions of 14 ft by 20 ft by 21 ft high. It houses a solids-liquids flash mixer, a mix tub, and associated piping. Cement and other solids are pneumatically conveyed into a metering tank above the mix cell and then flow into the solids-liquids mixer where they are combined with the liquid waste stream to form the grout. The grout flows into the mix tub which serves as a deaerator and as a feed vessel for the injection pumps.

2.4.2.4 Control Room and Service Areas

Adjacent to the shielded cells is a control room approximately 28 ft by 16 ft by 13 ft high in which all instrumentation and electrical controls are located. Viewing windows and periscopes are provided between the control room and the three cells to permit direct observation of the cell operations. A change room, sized for twenty people and equipped with shower and locker facilities, leads to a corridor which provides access thru shielding doors and a labyrinth arrangement into the shielded cell areas. A compressor room houses air compressors, air dryers, process water backflow preventer, and hot water heater. A small equipment room above the compressor room houses electrical switchgear, ventilation equipment, and other miscellaneous items. These control and service areas are of masonry construction. The control and change rooms are heated and air conditioned with a packaged unit. Cells are maintained at a negative pressure of less than one-half in. water gage with a system which provides ten air changes per hr and which is equipped with inlet roughing filters and dual high efficiency exhaust filters. This cell system also includes dual parallel exhaust fans, dampeners, and pressure gages for manual control. Emergency power to this system is not required. The mixing tub is served by a separate off-gas connection directly to the dual fans and which is equipped with a separate set of double high efficiency filters.

2.4.2.5 Solids Blending, Storage, and Metering

Two new 500,000 lbs bulk storage tanks will be provided from which the cement based solids are pneumatically conveyed to the mixing cell. A small metering tank, located directly above the mixing cell, is required to meter the solids from the bulk storage bins into the solids-liquids mixer. Solids will be batched in a weigh tank and blended by repeated pneumatic transfers between two small blend tanks. After blending, the solids will be pneumatically conveyed to one of the two bulk storage tanks.

2.4.2.6 Injection Well

The injection well was installed in advance of this project by drilling to a depth of 1100 ft to accept a 5-1/2 in. casing which was fully cemented for the entire depth. A 9-5/8 in. surface casing was also installed down to a depth of 250 ft. A wellhead assembly rated at 10,000 psi will be installed as part of this project.

2.4.2.7 Monitoring Wells and Bench Marks

An array of eight gamma monitoring wells (four installed in advance of project funding) will surround the well at distances of 200 to 500 ft to permit location of the grout sheets after each injection. The wells are to extend to the same depth as the injection well and have a 2-1/2 in. cemented casing. A network of eight rock cover wells with the lower 100 ft uncased will extend to a depth of approximately 700 ft. These wells will permit periodic pressure testing of the rock cover to ascertain that vertical fractures have not developed. A network of bench marks, spaced at 200 ft intervals, will be placed on the four compass points out a distance of 2000 ft to permit accurate measurement of the surface uplift caused by the waste injection.

2.5 Facility Personnel and Operation

This facility is intended to replace an existing similar facility and will not require additional operating and supervisory personnel. Injection operations are carried out on an intermittent basis with a maximum frequency of one per month. Maximum manpower occurs at the time of an injection with distribution as follows:

HNL Supervisory and Technical	3
Injection Subcontractor Supervisory	3
Injection Subcontractor Operating	7
HNL Craft and Operating	6
Health Physics Surveyor	1
	20

3.0 PROJECT JUSTIFICATION

The disposal of HNL waste by hydrofracture into shale formation in Melton Valley has been reassessed and compared with several alternatives, and hydrofracture appears to be the most attractive method in all respects. Solidification and near surface storage on-site require expensive handling and storage facilities and long-term surveillance of the waste. Shipment of the solidified waste to a central repository would prove also to be many times more expensive and, at the moment, a repository for such waste does not exist. No flaws or unacceptable risks can be seen in placing the wastes approximately 700-1000 ft underground in grout sheets in impermeable shale formations hundreds of feet below the water table.

The New Hydrofracture Injection Facility would provide the capability for disposal of the old stored wastes, including sludges, as well as new wastes (up to 20 Ci/gal). The existing hydrofracture facility was built as an experimental system with the minimum of operating convenience and only marginal shielding and containment ventilation. When converted to an "operational" facility in 1968, two used tanks were acquired and buried underground as on-site feed tanks along with three existing tanks for the liquid wastes. These tanks are not equipped to permit handling the Gunite tank sludges. In addition to the limitations of this surface facility, a major part of the usable 300 ft deep shale formation was consumed during the experimental program. While only about 1.5 million gallons have been injected into the present well, the point of injection is well above the midplane in the formation.

The capacity of the proposed new well is estimated at about 10 million gallons, based on the limit of four 100,000 gal injections in each slot and a slot spacing of 10 ft for the 300 ft thick disposal formations. This is sufficient for disposal of the Gunite tank sludges and new wastes at the present generation rate for at least thirty years.

In accordance with the National Environmental Pollution Act, an environmental impact statement covering this project is in the final stages of preparation. The results of the environmental study show that hydrofracture disposal operations as carried out at HNL will have no significant near- or long-term impact on the environment because of the isolation of the disposal zone from the biosphere.

4.0 PROPOSED METHOD OF ACCOMPLISHMENT

It is proposed that the project be accomplished by the Energy Research and Development Administration, Union Carbide Corporation, a solids handling vendor, an architect-engineer, a lump-sum prime contractor, and a cost-plus-fixed-fee prime contractor. All participants will be under prime contract to the ERDA. Participant responsibilities will be as follows.

4.1 Energy Research and Development Administration

The Energy Research and Development Administration will provide over-all project coordination, conduct foundation investigations (by Corps of Engineers), review and approve Title I and II design documents, review and approve the Safety Analysis Report, reproduce design drawings for fixed price bidding, and administer all prime contracts.

4.2 Union Carbide Corporation

UCC-ND will provide engineering services, special procurement, shop and field support as follows:

Engineering services will include: preparation of a Safety Analysis Report; Title I and II engineering for all improvements to land and for installation of all process and instrument systems, outside utilities, transfer lines, and bench marks; all engineering required for UCC-ND procurement and solids handling vendor contract; design criteria and review of any Title I and II design prepared by an architect-engineer; and all Title III engineering.

Procurement will include: all long-delivery process equipment; stainless steel piping, fittings, valves, etc.; process and radiation monitoring instruments; vendor services for installation of all wells; and all lead glass windows and other special viewing equipment.

Shop and field support will include: shop fabrication, assembly, and checkout of instrument control panels; shop bending of pipe and machining support for fabrication of transfer line components; modifications to existing equipment, such as existing injection pumphead; installation of bench marks; and furnishing all labor for final tie-ins to existing utility systems.

4.3 Solids Handling Vendor

An experienced solids handling vendor will be selected by competitive fixed price bidding to provide design, equipment, fabrication, erection, installation, and startup of new blended solids storage and metering system consisting, primarily, of two large storage tanks and a feed hopper with interconnecting conveying and metering systems.

4.4 Architect-Engineer

Depending on projected UCC-ND workload, an architect-engineer may be selected for the design of the basic building structure, including service systems, following the award of contracts for the purchase of all major process equipment and the new solids handling system.

4.5 Lump-Sum Prime Contractor

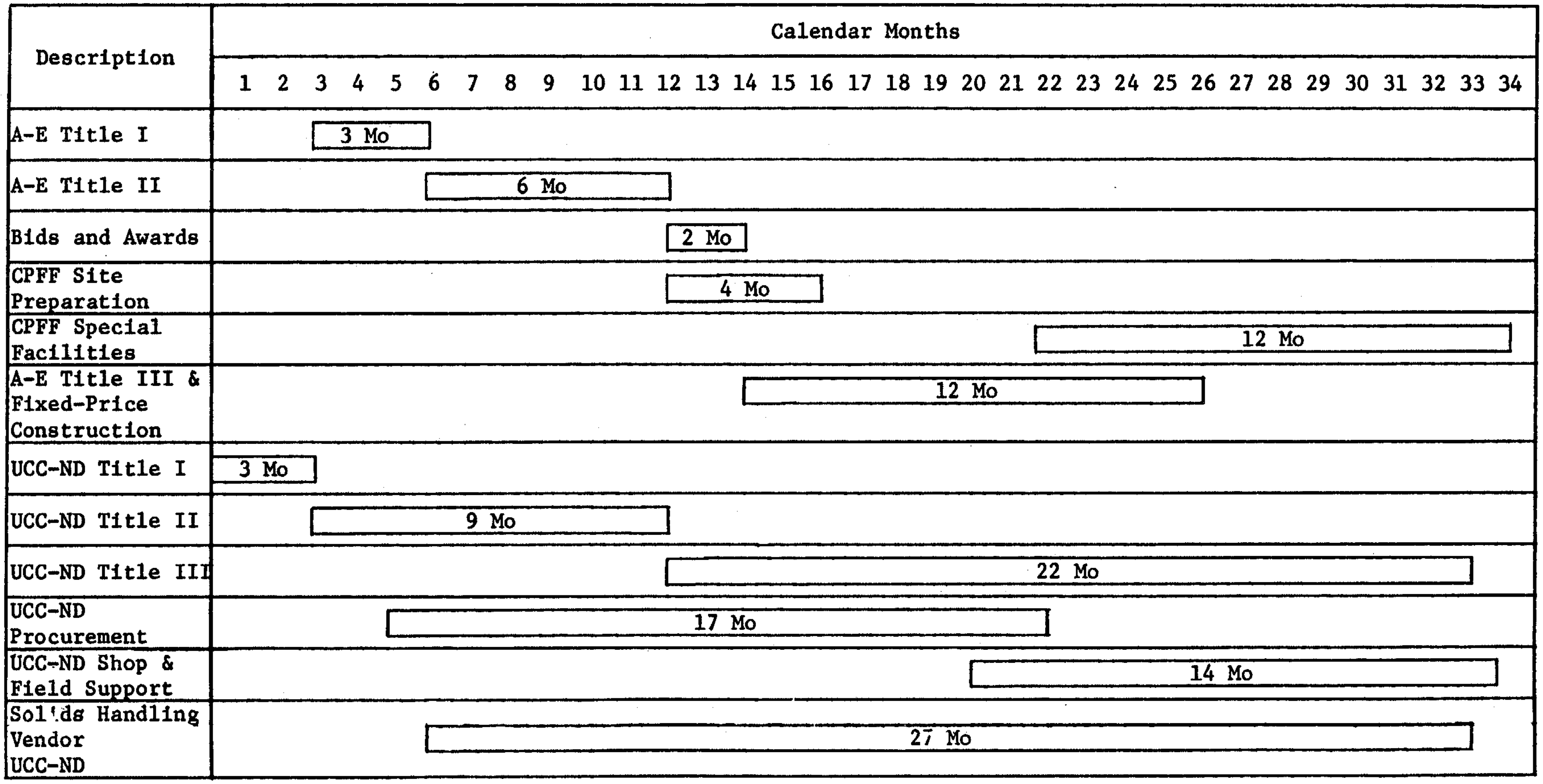
A general construction contractor will be selected by competitive fixed-price bidding for the construction of the basic building structure, including service systems.

4.6 Cost-Plus-Fixed-Fee Contractor

A CPFF contractor under prime contract with the Energy Research and Development Administration will perform all other project construction consisting primarily of the following:

Building excavation and backfill and all improvements to land; installation of waste transfer lines, outside utilities, and all new process equipment and instruments; and relocation and installation of all existing process equipment.

5.0 ENGINEERING AND CONSTRUCTION SCHEDULE



6.0 COST ESTIMATE

Total project costs including contingencies are estimated at \$3 million. These cost estimates are summarized on the next page, showing engineering and construction costs and breakdown by participant.

7.0 FLOOR AREAS, GROSS CUBAGE, AND UNIT COST DATA

Gross Floor Area	5,850 sq ft
Gross Volume (cubage)	80,860 cu ft
Unit Costs*	Direct Cost to 5 Ft Line with Contingencies
Area	\$96 per sq ft
Cubage	\$ 7 per cu ft

*Unit costs do not include site development and outside utilities.

8.0 ENVIRONMENTAL AND SAFETY ASSESSMENT

8.1 Design Basis Waste Characteristics

The proposed facility will be designed to handle three types of radioactive liquid wastes:

(1) Currently generated intermediate level waste (ILW) which totals about 100,000 gal per year of concentrate. This waste will be a salt solution (1 M $NaNO_3$ and other minor constituents) containing up to 2 Ci/gal of beta-gamma activity. Generally, the major radionuclide is ^{137}Cs with ^{90}Sr averaging 0.1 Ci/gal or less. The major alpha activity is ^{244}Cm (from the heavy element production program) with a concentration of about 1 mCi/gal.

(2) The sludges produced by waste processing and handling practices during the last three decades and which are currently stored in the Gunite waste tanks. There are about 350,000 gal of these sludges. Analyses indicate that these sludges contain between 500,000 and 800,000 Ci of ^{90}Sr, between 60,000 and 90,000 Ci of ^{137}Cs, around 12,000 Ci of ^{244}Cm and between 250 to 310 Ci of ^{239}Pu. It is anticipated that sometime in the future these sludges will be resuspended, diluted by a factor

SUMMARY COST ESTIMATE

NEW HYDROFRACTURE FACILITY

	AE	CPFF	LS Prime	ERDA Direct	UCC-ND	Total
Engineering Design & Inspection (approximately 23% of construction cost)	$175,000	—	—	$10,000	$315,000 1/	$ 500,000
Design	125,000			10,000 2/	222,000	
Inspection	50,000				93,000	
Construction Costs	—	$647,000	$812,000	—	$745,000 3/	$2,204,000
Improvements to Land			95,000			
Building Cost to 5-Foot Line			532,000			
Special Facilities, including process equipment		562,000	128,000		735,000	
Outside Utilities		85,000	57,000		10,000	
Standard Equipment			$ 87,000		$ 39,000	$ 126,000
				Subtotal		$2,830,000
Allowance for Contingencies (approximately 34% of total cost)						$ 970,000
Total Project Cost (escalated to April 1979)						$3,800,000

1/ Development of design criteria, review of design documents, and project management, including Quality Assurance Program.

2/ Subsurface investigation by Corps of Engineers, reproduction of bid drawings, and concrete testing.

3/ Includes subcontract for blend bulk storage and feed hopper tank fabricator.

of 4 to 5, and pumped to the Shale Fracturing Facility for disposal. This waste will have a specific activity of about 0.5 Ci/gal of ^{90}Sr.

(3) Future pilot plant wastes. Several pilot plant programs have been proposed for HNL that will generate appreciable quantities of waste having a higher specific activity than that which has been disposed of heretofore. Disposal of such wastes (after suitable storage for decay of short-life radionuclides) can be accomplished with the proposed Shale Fracturing Facility. These wastes would be stored for at least five years, neutralized, and diluted to a specific activity low enough for the new facility to handle. The shielding and containment of the surface facility will be designed to handle waste with a specific activity of at least 20 Ci/gal. For waste that has been cooled five years, about 10 Ci/gal of this activity would be from the remaining short-life radionuclides (mainly ^{147}Pm and ^{144}Ce); and the concentrations of ^{137}Cs and ^{90}Sr would be about 5 Ci/gal each.

The estimated radionuclide composition for each of these three waste types is given in Table 2. Since the five-year cooled, diluted, pilot plant waste solution has the highest specific activity and the highest concentration of hazardous radionuclides, this waste is used as a basis for assessing the safety and environmental impact of the Shale Fracturing Facility. The specific activity of all waste disposed of by shale fracturing will average much less than that for this maximum activity waste due to the larger volumes of the ILW and sludge types to be handled.

The long-term hazard associated with these wastes is relatively low, since the wastes contain only small quantities of ^{239}Pu. The ^{90}Sr and ^{137}Cs will decay to insignificant levels in 500 to 700 years, a relatively short time when compared to the expected isolation time of greater than 100,000 years. The ^{239}Pu will remain in the formation, but its concentration in the disposal formation at the conclusion of the waste injection operations will average less than 0.1 μCi/kg. This is within the range of naturally occurring ^{226}Ra, a radionuclide with a hazard roughly comparable to that of ^{239}Pu.

Table 2. Anticipated Waste Solutions

Waste	Isotope	Specific Activity (Ci)	Total per Typical Injection (Ci)
ILW	^{137}Cs	1	100,000
	^{90}Sr	0.1	10,000
	^{239}Pu	1×10^{-6} to 1×10^{-5}	0.1 to 1.0
	^{244}Cm	1×10^{-3}	100
Sludge	^{137}Cs	0.067	6,700
	^{90}Sr	0.53	53,000
	^{239}Pu	2.5×10^{-4}	25
	^{244}Cm	8.0×10^{-3}	800
Pilot-Plant Wastes	^{137}Cs	5	500,000
	^{90}Sr	5	500,000
	short-life	10	1,000,000
	^{239}Pu	1×10^{-4}	10
	^{244}Cm	0.025	2,500

8.2 Unavoidable Hazards

8.2.1 Seismic Effects

Oak Ridge is located in an area of moderate earthquake damage (Zone 2). It is about midway between the Zone 3 areas of major damage centered around Charleston, South Carolina, and around Memphis, Tennessee. Data on earthquakes prior to 1900 are extremely fragmentary; there is only one reported shock with an epicenter within 100 miles of Oak Ridge and an intensity greater than V (modified Mercalli scale) for this period.* Since 1900 there were fifteen reported shocks with an epicenter within 100 miles of Oak Ridge and an intensity of V. There were three shocks of intensity V-VI, seven shocks of intensity VI (a few instances of fallen plaster or damaged chimneys), three shocks of intensity VI-VII, one shock of intensity VII (damage negligible in buildings of good design and construction), and no shocks of intensity greater than VII. The one shock with an intensity of VII occurred on March 29, 1913, and had an epicenter at or near Knoxville, Tennessee. The nearest recorded earthquake with an epicenter greater than VII occurred in January 1905, and had an epicenter near Gadsden, Alabama - 170 miles away. This shock was of intensity VIII (damage slight in specially designed structures, considerable in ordinary buildings).

All surface structures at the New Hydrofracture Facility will be designed in accordance with Zone 2 seismic requirements of the 1973 Edition of The Uniform Building Code.

8.2.2 Winds and Tornadoes

All surface structures at the New Hydrofracture Facility shall be designed in accordance with the requirements of ANSI Standard A-58.1-1972 except as noted below.

All concrete shielded cell structures shall be designed to withstand the design basis tornado now being established for the Oak Ridge area. All characteristics of this tornado will be defined by UCC-ND prior to the start of Title I design.

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*Seismic History and Seismicity of the Southeastern Region of the United States, W. C. McLain and O. H. Myers, ORNL-4582 (June 1970).

8.2.3 Floods

The design elevations of the floor of the waste pit of the New Hydrofracture Facility is 768 ft. The maximum probable flood that has been estimated for the Clinch River watershed is 768 ft at the discharge of White Oak Creek.* A flood of this magnitude would not be expected to have any effect on the fracturing facility; all structures of the facility will be well above this flood stage. If the flood crest were higher than that of the maximum probable flood, no effects would be anticipated until the crest reached 779 ft; at this crest level the waste pit could be flooded and some activity could start migrating into the emergency waste pit. Any activity that migrated from the waste pit would be retained in the emergency waste pit until the flood level reached an elevation of 786 ft.

8.2.4 Failure of Services

A failure of services that occurs at any time except during an injection will have no effect on any part of the disposal facility. A failure of services during an injection will force the termination of the injection, unless the failure is of short duration (no more than fifteen minutes). The facility is designed so that either the injection pump or the standby injection pump can be used to clear the injection well and end an injection in case of need. These pumps are diesel powered and would not be affected by a service failure.

8.2.5 Fire

The facility will be protected by means of a wet-pipe sprinkler system in all areas except those for the two diesel powered injection pump drives where deluge protection will be provided. These two areas will also be separated by means of a four-hr rated wall and a separate underground fuel tank will be provided for each drive.

8.2.6 Leaks and Accidents

Waste solution will be stored in the two new waste storage tanks in Melton Valley. These tanks and their integrity have been described in the Conceptual Design Report for the ORNL Intermediate Level Waste System

*Floods on Clinch River and East Fork Poplar Creek in Vicinity of Oak Ridge, Tennessee, TVA Report No. 0-5922, Sept. 1959.

Modifications, ORNL-TM-4455. During a shale fracturing injection, waste solution will be pumped from these storage tanks to a mixer where the waste will be mixed with cement solids to form a grout. The waste-cement grout will be pumped down the injection well and out into the shale formation at a depth of 800 to 1100 ft. The underground transfer lines that carry the waste solution into the cell structure will be doubly contained and monitored to detect any leakage that might occur. The cell structure will be designed to provide secondary containment for all waste and grout handling, piping, and equipment installed within the cells. These cells and the mixing tub will be equipped with ventilation and off-gas systems designed to prevent the release of airborne contamination. While remote, it is possible for a wellhead rupture to occur late in the course of an injection and allow a large volume of grout to flow back out of the disposal formation and up the injection well. The consequences of such an accident have been minimized by the inclusion of an enclosed emergency waste pit in the lower part of the main cell structure for the purpose of collecting and containing the maximum expected flowback. No release of radionuclides would be expected in this case.

A small volume of water normally separates from the grout as it sets. This water will contain some radionuclides and will be allowed to bleed back up the injection well for collection and return to the waste storage tanks. Wash water and the other residues from the well casing slotting operation will be collected in the waste pit for injection with the next batch of waste solution or transfer back to the storage tanks.

It is possible for the orientation of the fracture formed in the shale during a waste injection to be vertical rather than horizontal, and, thus, allow some quantity of grout to reach the surface. The formation of such a vertical fracture in the bedded shales at Oak Ridge during a waste injection is considered to be highly improbable. The depth of the injection zone is so great as to make the probability of formation of a vertical fracture reaching the surface extremely remote. The consequences of such an incident have been evaluated, however, and found to be small. The leach rates of significant radionuclides from any ejected grout would be low and the net loss of radionuclides would be small, even under the worst conditions. For most of the accident situations postulated, the radionuclide concentration in the Clinch River would not exceed the concentration guide.* For the worst postulated situation, the estimated life-time dose to the critical organ of a person drinking water from the Clinch River would be between 70 and 100 millirems. Drilling operations in the vicinity of the disposal formation are not likely to be of concern. Wells have been drilled through grout sheets at the existing site and only minor amounts of activity have been found in the drilling water.

8.2.7 Long-Term Safety

The permanence of disposal of radioactive wastes by the shale fracturing process is exceptional. The disposal formation is quite impermeable and no mechanism is known that would result in surface water reaching the grout sheets. Even if water should reach the grout sheets by some mechanism, the quantity of radionuclides leached would be exceedingly low. The impermeability of the shale above the disposal formation is periodically monitored by means of rock cover wells to detect any change in shale permeability that might occur.

8.3 Analysis of Environmental Impact

The overall environmental impact of the New Hydrofracture Facility is expected to be beneficial. The facility will remove large volumes of potentially hazardous radioactive wastes from the existing surface storage facilities and fix these wastes in impermeable shale formations, well removed from the biosphere. The possible adverse environmental effects from normal operation (a rise in the temperature of the shale formation caused by heat generation of embedded wastes and a very small ground surface uplift) are not considered to be significant. All major accident situations postulated are considered to be quite improbable and the analysis of each case has indicated the ultimate release of radionuclides to the environment to be small.

8.4 Quality Assurance

All parts of the facility required for the primary containment of radioactivity, failure of which could cause an extended or costly delay

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*"Standards for Radiation Protection," AEC Manual, Chap. 0524, Annex A (Nov. 1968).

or hazards to personnel, will be classified as Quality Level II. This includes the primary waste transfer lines and the high pressure wellhead equipment. All other portions of the facility will be classified as Quality Level III.

9.0 OUTLINE SPECIFICATIONS

9.1 Site Improvements

9.1.1 Reference Drawings

Preliminary design drawings which show work to be accomplished are:

X-21255-EA-001-E

X-21247-EA-005-E

9.1.2 Clearing and Grading

The site shall be cleared of trees, brush, etc. Grading shall be accomplished as shown on the drawings to provide for roads, parking areas, surface drainage, waste storage basin, etc.

9.1.3 Storm Drainage

New storm drains, culverts and ditches shall be constructed as indicated on the drawings. All new storm drainage construction shall blend with and tie into the existing surface runoff facilities in the immediate area. New culverts and drains shall be constructed of reinforced concrete pipe or corrugated metal pipe.

9.1.4 Foundation Drainage

Foundation drains shall consist of concrete field tile surrounded by crushed stone backfill. Drains shall be provided around all structures as required to provide proper drainage.

9.1.5 Roads and Parking Areas

All roads and drives within the fenced area shall be 1-1/2 in. asphaltic concrete on 8 in. compacted stabilized base coarse. Minimum roadway paving width shall be 20 ft with 5 ft minimum width shoulders of stabilized base. All parking and vehicle loading and service areas shall be stabilized base with crushed stone surfacing having a minimum thickness of 8 in.

9.1.6 Sanitary Waste Handling

Sanitary sewage treatment will be provided by septic tank and drain field. The existing soil percolation capability will be determined by UCC-ND in accordance with the latest Tennessee State Department of Public Health Regulations. The septic tank and drain field will then be sized to accommodate the projected population and the above regulations.

9.1.7 Security Fence

The New Hydrofracture Facility and existing waste storage tank area shall be enclosed within a security fence conforming to the requirements of AEC Appendix 2401.

9.1.8 Finish Grading and Seeding

All areas disturbed by construction shall be graded to the finished contours as shown on drawings. Seeding, fertilizing, and mulching shall be provided.

9.2 Excavation and Backfill

9.2.1 Excavation

Earth and rock excavation shall consist of removal of material for installation of footings, catch basins, drains, waste transfer pipelines, etc. Excavation shall include only what is necessary for proper construction and inspection.

9.2.2 Backfill

Backfill shall be crushed stone, stabilized aggregate, or soil as appropriate for application. Backfill shall be placed in 6-in. horizontal layers and compacted to a density of at least 95% of maximum at optimum moisture as determined by AASHO Method T-180. All backfill around waste transfer pipelines shall be select clay in accordance with Section 9.8.5.

9.3 Structural - Architectural

9.3.1 Codes and Standards

Y-EF-358, General Design Criteria

9.3.2 Hydrofracture Building

9.3.2.1 Reference Drawings

X-21255-EB-001-D - Basement and First Floor Plan

X-21255-EB-002-D - Roof Plan

X-21255-EB-003-D - Section

X-21255-EB-004-D - Door & Room Finish Schedule

9.3.2.2 Foundations

All foundations shall be of reinforced concrete construction. Building and shielding walls shall be supported on spread footings. The footings will bear on weathered shale permitting an allowable bearing pressure of 4000 pounds per square foot, or on fresh shale, permitting an allowable bearing pressure of 12,000 pounds per square foot. All foundations shall be a minimum of 3 ft-0 in. below grade.

9.3.2.3 Structure

Concrete for the footings, interior cell walls, floors and pads shall have a compressive strength of 3000 pounds per square inch at 28 days. Concrete for cell roofs and exterior pads and walls shall have a compressive strength of 4000 pounds per square inch at 28 days.

All concrete cell structure shall be designed to resist the design basis tornado specified in Section 8.2.2 of this report and Zone 2 seismic loads.

Rolled structural steel framing shall be used for the support of enclosures for the well pipe storage tower and exterior pump engine rooms.

9.3.2.4 Exterior and Load Bearing Walls

Exterior and load bearing walls shall be of standard shalite aggregate concrete blocks reinforced to meet the Zone 2 seimic requirements of the Uniform Building Code (1973).

9.3.2.5 Interior Walls

Interior walls will be of standard shalite aggregate concrete blocks.

9.3.2.6 Fire Walls

The partition wall between the Injection and Standby Pump Engine Rooms shall have a fire resistance rating of four hours.

9.3.2.7 Siding and Panels

Siding for the well pipe storage tower shall be aluminum corrugated industrial sheet. Panels on the Pump Engine Rooms shall be removable louvers.

9.3.2.8 Roof

Roof of the structure will consist of 20-year bonded type, 4-ply organic felt, asphalt bitumen and aggregate surface applied over rigid insulation board and vapor barrier on concrete and metal roof deck surfaces as indicated on the drawings.

9.3.2.9 Floors

The emergency waste pit, tank pit, and corridor floor slab shall be supported on 4 in. of crushed stone fill. A premolded membrane vapor seal of semi-rigid asphalt core board shall be installed between the floor slab and the crushed stone. Other floor slabs on grade shall be supported on 4 in. of crushed stone on compacted fill. A plastic film moisture barrier shall be installed between the slab and the crushed stone. The cell floor shall be solid concrete slab and beam construction (as required at plugs). The equipment room floor slab shall consist of concrete topping over concrete plants.

Floor finished shall be as indicated on Room Finish Schedule on Dwg. EB-004-D and as specified under 9.3.2.14 below. Vinyl asbestos tile with 4 in. high vinyl topset cove base shall be used in the control room, office, tool stores, entry, men's toilet and change room. All concrete floors and equipment pads shall be designed to satisfy the requirements of applicable building and the live loads and additional requirements indicated below:

Live Loads. 150 lb/ft^2 for all areas including steel platform and roof of cells.

Additional Requirements. All installed equipment loads.

9.3.2.10 Doors

Sizes, locations, hardware, and materials of construction for all doors shall be as indicated on Dwg. EB-004-D, Door Schedule. All doors shall be hollow metal with pressed steel or structural shape frames.

9.3.2.11 Ceilings

Exposed underside of metal deck, beams, concrete planks, and slabs shall be finished as indicated on the Room Finish Schedule on Dwg. EB-004-D.

9.3.2.12 Change Room Furnishings

Change room furnishings shall consist of two packaged double tier lockers, dirty clothes bin, birch seat drying bench, and clean clothes shelving.

9.3.2.13 Waterproofing

The emergency waste pit, tank pit, and corridor floors and walls shall be waterproofed with a premolded membrane semi-rigid asphalt core board.

9.3.2.14 Painting and Protective Coating Systems

The Room Finish Schedule for interior finishing is shown on Dwg. EB-004-D. Four basic painting and protective coating systems are specified as follows:

(1) Epoxy-Polyamide Resin (Amercoat 66) or modified phenolic (Carboline 300) system shall be applied to the floor surfaces as indicated. Surface preparation, primer and application shall be in accordance with the manufacturer's recommendations and total dry film thickness shall be 20 mils. Sand shall be broadcast in the last coat to provide a slip resistance finish.

(2) Epoxy-Polyamide Resin (Amercoat 66) or modified phenolic (Carboline 300) system shall be applied to wall and ceiling surfaces as indicated. Surface preparation, primer, and application shall be in accordance with the manufacturer's recommendations and total dry film thickness shall be 8 mils.

(3) Masonry filler and/or primer and latex finish coat shall be applied to interior and exterior masonry and concrete surfaces in accordance with the manufacturer's recommendations.

(4) Semi-gloss enamel conforming to Federal Specifications TT-E-508 for interior service and TT-E-489 for exterior service shall be applied to carbon steel surfaces designated to receive paint.

9.3.2.15 Hoist

An eight-ton hoist shall be installed in the Well Pipe Storage Tower for handling of well pipe string. Both movements shall be motorized and controlled by pendant pushbutton stations from the Well Pipe Storage Tower platform and floor levels.

9.3.3 Solids Storage and Handling Facilities

9.3.3.1 Reference Drawings

X-21255-EA-001-D - Grading Plan

9.3.3.2 Support Foundations and Pump Pads

Soil bearing capacity and concrete shall be as specified under 9.3.2.2 and 9.3.2.3 above.

9.3.3.3 Support Structure

Rolled structural shapes or pipe shall be used to support the solid storage tanks. Rolled structural shape or pipe and steel joist shall be used to support the solids handling transfer pipes.

9.3.3.4 Painting

Carbon steel surfaces not painted by the manufacturer shall be painted as specified under 9.3.2.14.

9.4 Heating, Ventilating, and Air Conditioning

9.4.1 Codes and Standards

Applicable sections of the Codes and Standards listed below shall be followed in the design of the New Hydrofracture Facility Project:

AEC General Design Criteria, Appendix 6301

Minimum Safety Requirements, AEC-ORO

Occupational Safety and Health Act Standards

UCC-ND Engineering Standards

UCC-ND Technical Specifications

UCC-ND General Design Criteria Y-EF-538

American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals

ASHRAE Guide and Data Book - Applications

ASHRAE Guide and Data Book - Equipment

ASHRAE Handbook - Systems

Industrial Ventilation - American Conference of Governmental Industrial Hygienists

Air Moving and Conditioning Association (AMCA) Standards Handbook - Publication 99

AMCA Fans and Systems - Publication 201

AMCA Director - Publication 261

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) High Velocity Duct Construction Standards

9.4.2 Outside Design Basis Conditions

	Dry Bulb Temp. °F	Wet Bulb Temp. °F
Summer	92	76
Winter	10	

9.4.3 Containment Ventilation Systems (Reference Dwg. X-21255-EG-001-D)

The pump cell and well cell shall be maintained at a negative pressure of 1.0 in. w.g. with respect to the outside atmosphere. Each cell shall receive six air changes per hour from the equipment room. The supply air shall be HEPA filtered before leaving the equipment room. The exhaust system shall contain HEPA filters in each cell and at the fan inlet. The exhaust system shall be ducted from each cell thru the compressor room and equipment room and finally discharged above the roof of the building.

The basement corridor shall receive six air changes per hour from the cell supply system and shall be exhausted by the cell exhaust system as described above. The basement corridor shall be maintained at a negative pressure of 0.6 in. w.g. with respect to outside atmosphere.

The emergency waste pit shall receive six air changes per hour from the cell supply system and shall be exhausted by the cell exhaust system as described above. The emergency waste pit shall be maintained at a negative pressure of 1.0 in. w.g. with respect to outside.

The tank pit located below the emergency waste pit shall be exhausted by the cell exhaust system. The tank pit shall be maintained at a negative pressure of 1.0 in. w.g. with respect to outside. The tank pit shall be ventilated by in-leakage from the emergency waste pit.

The mixing cell shall be maintained at a negative pressure of 1.0 in. w.g. with respect to outside and shall receive six air changes per hour from the equipment room. The mixing cell and the mixing tub located inside the cell shall be exhausted using a separate exhaust system. The mixing tub shall be maintained at a negative pressure of from 0.25 to 1.0 in. w.g. with respect to the mixing cell. The mixing tub vessel off-gas shall receive double HEPA filtration and the cell ventilation exhaust shall receive triple HEPA filtration. Normal ventilation thru the mixing tub shall be by in-leakage only.

9.4.3.1 Equipment List

(1) Cell Exhaust System Exhaust Fan. Fan shall exhaust 1550 cfm at 4 in. s.p., shall be SWSI with backwardly inclined blades, 3 hp motor, and vibration isolation base. Fan shall be Barry Blower Industrial, Size 611.

(2) Cell Exhaust System Filter Enclosures. Side loading filter housing to enclose two 24 in. x 24 in. x 12 in. HEPA filters and two 24 in. x 24 in. x 2 in. prefilters. Prefilters shall be supplied with housing. HEPA filters shall be supplied by UCC-ND. Housing shall be MSA Ultralock Part No. 455382.

(3) Cell Supply System Filter Enclosure. Same as Item (2).

(4) Differential Pressure Indicators. F. W. Dwyer Model 2002 with two A310 vent valves.

(5) Vessel Off-Gas and Cell Exhaust Fan. Fan shall exhaust 250 cfm at 4 in. s.p., and shall be SWSI with 1 hp motor and vibration isolation base. Fan shall be New York Blower Compact G. I. Size 10N.

(6) Cell Exhaust Filter Enclosures. Side loading filter housing to enclose one 24 in. x 24 in. x 12 in. HEPA filter and one 24 in. x 24 in. x 2 in. prefilter. Prefilters shall be supplied with housing. HEPA filters shall be supplied by UCC-ND. Housing shall be MSA Ultralok Part No. 455381. Five required.

(7) Mixing Cell Off-Gas Filter Enclosures. Side loading filter housing with bag-in-bag-out system to enclose one 24 in. x 24 in. x 12 in. HEPA filter and one 24 in. x 24 in. x 2 in. prefilter.

Prefilters shall be supplied with housing. HEPA filters shall be supplied by UCC-ND. Housing shall be MSA Ultralok Series U. Three required.

9.4.3.2 Ductwork

Ductwork shall be 304 stainless steel. Installation shall be in accordance with SMACNA High Velocity Duct Construction Standards. Duct sections shall be shop prefabricated to the extent economically practical. All joints shall be metal-arc welded and dye-penetrant inspected. Embedded duct shall be Schedule 10 or heavier, sufficient to carry the load imposed with failure or permanent distortion. Prefabricated sections of ductwork to be embedded shall have all welded joints soap bubble tested at 5 psig and shall have a 4-hour hold test performed prior to installation. Installed sections of duct to be buried shall receive a 4-hour, 5 psig pressure hold test before being buried. All buried duct shall be provided with cathodic protection. Ductwork and fittings shall be in accordance with Felkerweld Specifications by Felker Brothers Manufacturing Company.

9.4.3.3 Insulation

No insulation will be required on the cell supply system, the cell exhaust system, and the off-gas exhaust system ductwork.

9.4.3.4 Alarms and Controls

A visual alarm shall be provided to indicate loss of exhaust flow on a panel within control room. The systems shall be manually controlled by adjusting dampers in both the supply and exhaust systems. Supply air entering the equipment room shall be controlled by an automatic wall louver. The equipment room wall louver shall be operated by an electric interlock between cell exhaust and off-gas exhaust fans.

9.4.4 Office, Control and Change Room Systems (Reference Drawing X-21255-EG-001-D)

The control room shall be heated and cooled using a packaged recirculating roof-top unit. The unit shall recirculate approximately 665 cfm and exhaust approximately 450 cfm through men's toilet and the change room. The return air shall be HEPA filtered. The control room shall be maintained at a negative pressure of 0.3 in. w.g. with respect to outside.

The change room shall receive 290 cfm of conditioned air from the control room. A supplemental recirculating unit heater shall be provided. The exhaust shall be HEPA filtered. The change room shall be maintained at a negative pressure of 0.3 in. w.g. with respect to outside.

The rest room shall receive 160 cfm of conditioned air from the control room. A supplemental recirculating unit heater shall be provided. The exhaust shall be HEPA filtered. The rest room shall be maintained at a negative pressure of 0.3 in. w.g. with respect to outside.

The office shall be heated and cooled using a recirculating thru-the-wall air conditioning unit.

The entry and tool stores room shall be heated using baseboard heaters.

9.4.4.1 Design Conditions

The office and control room shall be designed to prevent space temperature from exceeding 78°F during the summer and dropping below 68°F during the winter. The change room, rest room, entry and tool stores room shall be designed to prevent space temperatures from dropping below 68°F during the winter. Ventilation rates for the change room and rest room are based on 2 cfm/ft^2.

9.4.4.2 Equipment List

(1) Control Room Air Conditioning Unit. Unit shall supply approximately 1100 cfm of conditioned air to the control room. Unit shall have four tons cooling capacity and 12 kW supplemental electric heat. Unit shall be McQuay Model RPS-004B-Y-33.

(2) Office Air Conditioning Unit. Unit shall supply approximately 300 cfm of conditioned air to the office and have 11,500 btu/hr cooling capacity and 4.5 kW supplemental electric heat. Unit shall be McQuay Model TPW-115A-E-33.

(3) Change Room Exhaust Fan. Fan shall exhaust 290 cfm at 1-1/4 in. s.p. Fan shall be SWSI with 1/2 hp motor. Fan shall be Buffalo Volume fan size 31, Type "V".

(4) Change Room Differential Pressure Indicators. Same as 9.4.3.1-(4) above.

(5) Change Room Unit Heater. Heater shall be electric with 2 kW capacity and shall be Chromalox Model CB-30.

(6) Rest Room Unit Heater. Heater shall be electric with 3/4 kW capacity and shall be Chromalox Model CB-7.

(7) Rest Room Exhaust Fan. Fan shall exhaust 160 cfm at approximately 1 in. s.p. Fan shall be SWSI with 1/3 hp motor. Fan shall be Buffalo Volume fan size 31, Type "V".

(8) Change Room Filter Housing. Same as Item 9.4.3.1-(6) above.

(9) Control Room Filter Housing. Same as Item 9.4.3.1-(2) above.

(10) Rest Room Filter Housing. Same as Item (8) above.

(11) Entry Heating Unit. Unit shall be cabinet model with 3 kW capacity. Unit shall be Chromalox Model KSF-363T.

(12) Tool Stores Heating Unit. Unit shall be baseboard type with 1 kW capacity. Unit shall be Chromalox Model BB-A-6L, 69 in. long.

(13) Control Room Thermostat. Thermostat shall be room type, single temperature with proportional action. Thermostat shall be Johnson Service Model T-4002.

9.4.4.3 Ductwork

Ductwork shall be galvanized steel fabricated in accordance with SMACNA Low Velocity Duct Construction Standards.

9.4.4.4 Insulation

The control room air conditioning system ductwork, both supply and return, shall be insulated where exposed to outside conditions. No other insulation shall be required.

9.4.4.5 Alarms and Controls

All heating and air conditioning units except the control room air conditioning unit shall have built-in controls. No alarms shall be required, however, the rest room and change room exhaust fans shall be interlocked with the control room supply fan to avoid excessive negative pressures. The control room, change room, and rest room negative pressures shall be maintained by manually adjusting supply dampers. The control room air conditioning unit shall use a pneumatic room type thermostat.

9.4.5 Equipment Room, Compressor Room, and Well Pipe Storage Tower Systems (Reference Drawing X-21255-EG-001-D)

The equipment room ventilation air is supplied through a motor operated wall louver interlocked with the cell ventilation and the off-gas exhaust fans. The equipment room shall be heated with a unit heater as described in Item 9.4.5.2. The equipment room ventilation shall provide supply air for the areas listed in Item 9.4.3.

The compressor room shall be heated using a unit heater. Also the compressor room shall use a temperature sensitive motor operated wall louver interlocked with a wall exhauster to preclude exceeding a maximum temperature.

The well pipe storage tower shall utilize an exhaust fan interlocked with a motor operated wall louver to provide ventilation. The supply and exhaust shall be HEPA filtered. The pressure drop across the supply HEPA filter will maintain the area at a negative pressure of -0.2 in. w.g.

9.4.5.1 Design Conditions

The inside design conditions for the compressor room shall be 105°F (maximum) in summer, and 50°F (minimum) in winter. The equipment room inside design conditions shall be 50°F (minimum) in winter. The well pipe storage tower shall have no temperature or humidity limitations.

9.4.5.2 Equipment List

(1) Compressor Room Exhaust Fan. Fan shall exhaust approximately 2000 cfm at 1/4 in. s.p. and shall be direct drive with 1/3 hp motor. Fan shall be Jenn-Air Model 168 CW.

(2) Compressor Room Unit Heater. Heater shall be ceiling mounted with built-in thermostat and 4 kW capacity. Heater shall be Chromalox Model LUH-04-07.

(3) Equipment Room Unit Heater. Heater shall be ceiling mounted with built-in thermostat and 40 kW capacity. Heater shall be Chromalox Catalog No. LUH-30-03.

(4) Equipment Room, Compressor Room and Well Pipe Storage Tower Automatic Wall Louvers. Louvers shall be electric motor operated with 1/2 mesh screen. Louvers shall be American Warming and Ventilating Model LW-D-3390.

(5) Well Pipe Storage Tower Exhaust Fan. Fan shall exhaust 1290 cfm at 4 in. s.p. and shall be SWSI with backwardly inclined blades, 2 hp motor and vibration isolation base. Fan shall be Barry Blower Industrial, Size 609.

(6) Well Pipe Storage Tower Filter Housings. Same as Item 9.4.3.1-(2) above.

(7) Equipment Room and Well Pipe Storage Tower Differential Pressure Indicators. Same as Item 9.4.3.1-(4) above.

(8) Compressor Room Thermostat. Same as Item 9.4.4.2-(13) above.

9.4.5.3 Ductwork

Same as Item 9.4.4.3 above.

9.4.5.4 Insulation

No insulation shall be required.

9.4.5.5 Alarms and Controls

The well pipe storage tower exhaust fan shall be interlocked with the motor operated wall louver. The equipment room motor operated wall louver shall be interlocked with the cell exhaust fan and the vessel off-gas exhaust fan. The compressor room shall utilize a room thermostat to control the room temperature between set points described in 9.4.5.1 above. The thermostat shall control both the wall exhauster and the unit heater.

9.4.6 Operation

The cell ventilation and the off-gas exhaust systems must operate continuously to maintain containment pressures. The control room, rest room, and change room system may be shut down in summer but they must operate in winter to provide freeze protection. The well pipe storage tower exhaust system must operate when contaminated materials are stored, but the system can be shut down at any other time.

9.5 Service Piping and Utility Systems

Pipe systems with related equipment and controls, shall be provided to meet the process and utility requirements of the facility. Systems to be provided include: water for potable, fire protection and process uses; compressed air, storm drains, process drains, and sewer drains.

Adequate loops, isolating valves, and controls shall be provided to facilitate maintenance and minimize interruption to services. Concrete encasement shall protect underground lines crossing roads and where lines containing potentially contaminated liquids or vapors cross potable water lines, creeks, and storm drains.

9.5.1 Codes and Standards

Brief descriptions of the various piping systems, including materials, fabrication methods, and insulation are given in the following paragraphs. Documents applicable to the design of the piping system are:

ERDA Design Criteria Appendix 6301

Standards listed in ERDA Manual, Chapter 0550, Operational Safety Standards

National Fire Codes of the National Fire Protection Association

Power Pipe Code, ANSI B 31.1

ASME Pressure Vessel Code, Section II, VIII, and IX

ASTM Specifications

9.5.2 Reference Drawing

X-21255-EE-001-E - Process & Service Engineering Flow Sheet

9.5.3 Potable Water

Potable water shall be supplied from the underground 6 in. water line presently serving the two 250,000 gal intermediate level waste storage tanks. The potable water will be distributed at ambient temperature to hose bibbs and all sanitary facilities. A potable water heater will be provided to supply hot potable water for rest room facilities.

The potable water system shall supply all the process water requirements through a reduced pressure principle backflow preventer.

9.5.4 Fire Protection Water

Water for fire fighting shall be supplied from the potable water system. Wet pipe sprinklers shall be installed in all the building spaces except the mixing cell, pump cell, and the well cell. A fire hydrant shall be installed near the building.

9.5.5 Compressed Air

Air compressors shall be installed in the compressor room of the building to supply: (1) approximately 5 psig pressure to bulk storage tank aerators and air slides; (2) 30 psig pressure to the scale and blending tank system; (3) 20 psig to the Fuller-Kinyon Pumps; and (4) 100 psig to storage tank air pads. The air from the 100 psig compressor shall be dried to an outlet dew point of -20°F. The dried air at 100 psig will be extended to the well cell. For instrument use, this dry air shall be reduced to 20 psig and piped to points of use.

All compressed air piping shall be steel or copper.

9.5.6 Storm Drains

Water from the roof drains, equipment room floor drain, and the compressor room floor drain shall discharge to storm drains and surface drainage systems designed to prevent erosion damage. Roof drains shall be cast iron soil pipe or galvanized steel within the building and vitrified clay beyond the 5-ft line.

9.5.7 Process Water

Process water shall be supplied from the potable water system through an approved reduced-pressure-principle backflow preventer.

Process water shall be supplied to all building applications other than sanitary, drinking, fire protection, and safety shower, eye wash, etc. All process water distribution piping except those in the cells shall be constructed of copper tubing or galvanized steel pipe and insulated with molded fibrous glass wool. Process water piping inside cells shall be welded stainless steel without insulation.

9.5.8 Process Waste

Each of the cells shall contain a sump for collection of process wastes consisting of decontamination agents, flush water, etc. The sump shall be pumped by a submerged sump to the slotting waste collection tank. All piping shall be welded 304L stainless steel.

9.5.9 Building Equipment List

(1) One - Air compressor shall have a capacity of $\sim$ 900 scfm at 30 psig and 100 hp, 3 phase, 60 cycle, 220/440 volt motor.

(2) One - Air compressor shall have a capacity of $\sim$ 85 scfm at 100-120 psig and a 20 hp, 3 phase, 60 cycle, 220/440 volt motor.

(3) One - Positive displacement blower which shall have a capacity of $\sim$ 500 scfm at 4-5 psig and a 15 hp, 3 phase, 60 cycle, 220/440 volt motor.

(4) One - Absorption type air dryer shall have a dew point of -40°F and a capacity of 85 scfm at 100 psig. Regeneration shall be by electric heat and controls shall be fully automatic to allow continuous operation.

9.6 Process Equipment - Building

9.6.1 Fabricated Equipment

9.6.1.1 Codes and Standards

ASME Pressure Vessel Code, Section II, VIII, and IX
ASTM Specifications
Power Piping Code, ANSI B 31.1
ERDA Manual, Chapter 0550

9.6.1.2 Design Conditions

(1) Slotting Waste Collection Tank. The slotting waste collection tank shall be a 3000 gal cylindrical vessel, 7 ft in outside diameter and 13 ft 9 in. high overall, with a standard ASME dished head at bottom and an open top. The vessel shall be equipped with legs for support. An agitator shall be required to keep in suspension a slurry of 4-6% by weight of a sand-cement mixture. The vessel shall have internal baffles as required for agitation. Supports shall be provided on top of the tank for the agitator and a walk way for maintenance access. All materials of construction shall be Type 304L stainless steel.

(2) Mixing Tub (Dwg. M-20974-EE-001-D). The mixing tub shall be an atmospheric pressure vessel having a cylindrical shell with ASME dished bottom and a flanged top; the outside diameter shall be 4 ft and the height 6.5 ft with a minimum volume of 600 gal. The vessel shall have provisions for visually viewing the grout in the tub from the control room through a shielded window. A flanged nozzle shall be provided on the top head of the vessel for mounting of an agitator. Two 5-in. flanged nozzles shall be located on the bottom of the vessel for use in transfer of grout to the well injection pump. The grout inlet nozzle shall be a 3-in. pipe and shall enter the side of the vessel.
The mixing tub and all piping and other internals shall be of all welded Type 304L stainless steel construction.
The piping shall be Schedule 40 and the flanges ASA 150 lb.
The mixing tub shall have a float type liquid level measuring device with an indicator arranged for viewing from the control room.

9.6.2 Purchased Equipment

(1) Agitators. Agitators shall be provided as accessories to the slotting waste collection tank for suspension of solids and to the mixing tube to aid in cleanup after operation. Shaft length, rpm, and propeller size shall be selected to suit vessel design and application. Agitator motors shall be 1750 rpm, 440 volt, 3 phase, 60 Hertz, NEMA design Class "C", and shall be totally enclosed, fan-cooled.
Data for agitators are summarized in the following table:

	Agitator M-1	Agitator M-2
Description	Grout Cleanup	Sand Suspension
Mixing System	Water & Grout	Water & 6% Sand Mixture
Mounting	Fixed	Fixed
Materials of Construction	CI & Type 316 SS	CI & Type 316 SS

(2) Mixing Jet. The mixing jet shall be a solids-liquids proportioning jet especially designed for this service. Materials of construction shall be Type 304 or 316 stainless steel.

(3) Mixing Hopper. The mixing hopper shall be designed to fit the mixing jet, to feed the dry solids into the mixing jet, and to allow direct observation of solids flow into the mixing hopper from the control room during operation. Materials of construction shall be Type 304 or 316 stainless steel.

(4) Pumps General. Injection pumps (P-3, P-4) - Two injection pumps will be required, one for standby (P-4) and one for grout injection (P-3). The existing Halliburton HT-400 pump located at the existing Hydrofracture Facility will be relocated at the new facility for use as the standby pump. A new pump will be purchased for the injection operation. This new pump will be similar to the existing pump except it will be a newer model and will have a modified pumping head to allow packing of the drive shaft from outside the cell shielding and a simpler replacement procedure for valve seats, cylinder inserts, etc.

Sump pumps (P-9, P-10) - All sump pumps shall have submerged inlets and flanged outlets with flat faced, ASA rating 150 psig flanges. Pump motors shall be 1750 rpm, 440 volts, 3 phase, 60 Hertz, NEMA design Class "C", and shall be either splash-proof or totally enclosed fan-cooled.

Slotting waste tank pump (P-8) - This pump shall be a progressive cavity type pump equal to the Moyno pump manufactured by Robbins & Myer's, Inc. The inlet and outlet connections shall be flat face, ASA rating 150 psig flanges. The materials of construction of the rotor shall be Type 316L or 304L stainless steel and the stator shall be Viton lined. The pump shall have a variable speed drive with a maximum of 300 rpm.

Specific pump requirements are as follows:

Process Pump Criteria

Pump Number	Description	Pumped Fluid	Capacity (gpm)	Approximate Head Requirement Feet	Material of Construction
P-3	new injection pump positive displacement	cement grout 42 to 54% solids	250	13,840	cast iron (CI) & stainless steel (SS) 304 or 316
P-4	existing injection pump positive displacement	cement grout 42 to 54% solids	250	13,840	cast iron and 304 or 316 SS
P-8	slotting waste centrifugal	water & 5% sand mixture	118	272	CI, SS, and Viton
P-9	cell floor sump pump centrifugal	process spills	20	20	Type 304 or 316 SS
P-10	waste vault sump pump centrifugal	water & process leaks	20	20	Type 304 or 316 SS

9.7 Process Equipment - Solids Handling and Storage (Reference Drawing X-21255-EE-001-E-0)

The solids handling and storage equipment will be used for the proportioning, blending, storage and feeding of bulk solid materials to the process. A maximum of 1,000,000 lbs of solids will be required for the disposal of each 100,000 gal of waste which is to be the normal injection or disposal batch size. The solids blend mixture required is as follows:

Material	Weight %
Cement	40.3
Fly Ash	40.3
Attapulgite Clay	16.1
Potter's Clay	3.2
Sugar	∿0.01

Raw material storage for the cement and fly ash is not required since these materials can be delivered to the site from local suppliers by bulk hopper trucks and fed directly to the scale tank as required. The attapulgite and potter's clay must be procured well in advance of blending operation and, thus, will require site storage. The three existing 2700 cubic foot storage hoppers, presently located at the existing hydrofracture site, will be moved to the new hydrofracture site for storage of these clays. The scale tank and the two blend tanks, now existing at the present hydrofracture site will also be moved to the new hydrofracture site and used for solids proportioning and blending operations. Air slide conveyors at the existing hydrofracture site will be moved to the new hydrofracture site and adapted for conveying raw materials from the storage hoppers to the scale tank. New foundation pads will be required for all existing hoppers or tanks at the new hydrofracture site. Two new bulk storage hoppers, each with a capacity of 500,000 pounds, will be required for the blended solids. Total volume of each vessel shall be approximately 9160 cu ft. These blend storage hoppers will deliver solids to a variable output air fluidizer which will pneumatically convey the solids to a new 820 cu ft feed hopper located on the roof of the mixing cell approximately a distance of 100 ft away. Vents on the blend storage tanks and the feed hopper shall be equipped with automatic bag filters for the removal of solids from discharge air.

The design of the new hoppers and the pneumatic conveying system for the blended solids shall be performed by a vendor having prior experience in the design and erection of such equipment. The two blend storage hoppers are of such size as to require erection by the same vendor.

9.7.1 Codes and Standards

ASME Pressure Vessel Code, Section II, VIII, and IX
ASTM Specifications
Power Piping Code, ANSI B 31.1
ERDA Manual, Chapter 0550

9.7.2 Design Conditions

(1) Blend Bulk Storage Hoppers. The blend bulk storage hoppers shall be vertical cylindrical vessels having ASME standard dished top heads and conical bottoms. The outside diameter of the vessel shall be 20 ft and the conical bottom shall be sized to allow mass flow of materials from the vessel. The design temperature shall be 100°F and the design pressure shall be 30 psig. The maximum feed rate from the blend storage hoppers shall be 75 tons per hr. The top of each hopper shall have a manhole and two six in. nozzles, one for filling and one for venting. Additional nozzles shall be added as required for instrumentation, air pads, and/or aerators needed to promote flow of solids out of the hopper. The bottom outlet from the cone shall conform to the requirements for mass flow feed from the vessel.

Personnel access ladders conforming to OSHA requirements shall be provided on interior and exterior of hoppers to facilitate access via top manhole for maintenance, inspection, etc.

Construction shall be all welded carbon steel. The vessel shall be code stamped according to ASME Code, Section VIII, Division 1.

The outside of the feed hopper shall be given three prime coats and two finish coats of paint to prevent corrosion. The inside of the feed hoppers shall be given one coat of primer "Dupont Corlar" 825-8031 and three coats of "Dupont Imron" polyurethane enamel according to the manufacturer's recommendations.

(2) Feed Hopper. The feed hopper shall be a vertical cylindrical vessel having an ASME standard dished top head and a conical bottom. The outside diameter of the vessel shall be 8 ft and the cone bottom shall be sized to allow free flow of materials from the vessel by mass flow.

The design temperature shall be 100°F and the design pressure shall be 30 psig. The maximum feed rate from the feed hopper shall be 75 tons per hr. The top of the vessel shall have a manhole with OSHA conforming personnel access ladders, both inside and outside, to facilitate access for maintenance, inspection, etc. There shall be two 8-in. nozzles in the top of the vessel to receive feed from each of the blend storage hoppers and one 6-in. nozzle for the venting. Additional nozzles shall be added as required for instrumentation, air pads, and/or aerators needed to promote removal of solids. Construction shall be all welded carbon steel. The vessel shall be code stamped according to ASME Code, Section VIII, Division 1.

The outside of the feed hopper shall be given three prime coats and two finish coats of paint to prevent corrosion. The inside of the feed hopper shall be given one coat of primer "Dupont Corler" 825-8031 and three coats of Dupont "Imron" polyurethane enamel according to the manufacturer's recommendations.

9.8 Process Piping - Waste Transfer

All radioactive waste transfer pipe lines shall have primary and secondary containment. Where the pipelines are located inside cells or valve boxes, the pipe is considered to be the primary containment and the cell or valve the secondary containment. When the waste transfer pipe lines are routed out of a cell or valve box, they shall be installed within a second pipe similar to the conceptual design shown on Dwg. X-20013-EA-020-E-0. Stress calculations shall be prepared and submitted for independent review to verify design of these "double pipe" systems in accordance with code requirements. These calculations shall consider design operating pressures, temperature differentials, allowable deflections between anchors, stress concentration at direction changes, etc. Means for leak testing the annular space between the primary and secondary line of all contained sections shall be provided. All low points and all high points in the pipe line shall be equipped with valved by-pass connections across partition plates which are accessible for venting, draining, etc., via nearby valve pits. The inner pipe line shall be Quality Level II and the outer pipe shall be Quality Level III according to HNL Quality Assurance Program.

9.8.1 Codes and Standards

ASME Pressure Vessel Code, Sections II, VIII, and IX
ASTM Specifications
Power Piping Code, ANSI B 31.1

9.8.2 Design Conditions

Maximum design temperature - 125°F
Maximum ΔT between inside and outside pipe - 76°F
Design pressure of inside pipe - 200 psig
Design pressure of outside pipe - 225 psig
Minimum shielding required - 4 ft of earth
Maximum flow rate through inner pipe - 250 gpm

9.8.3 Materials of Construction

Materials of construction for the inside pipe shall be 4 in., Schedule 40, seamless grade TP 304L stainless steel pipe manufactured and inspected according to ASTM Specification A 312.

Materials of construction for the outside pipe shall be 5- or 6-in., Schedule 10, seamless grade TP 304L stainless steel pipe manufactured and inspected according to ASTM Specification A 312.

Material of construction for partition plates shall be type 304L stainless steel bar manufactured according to ASTM Specification A-479-63 and the further requirement that it be acceptable per ultrasonic examination according to ASTM A-388-71.

Welding rod materials shall be ER 308L bare rod manufactured and inspected according to ASME Boiler and Pressure Vessel Code, Section II, Part C, Material Specification SFA-5.9.

Materials of construction for the 1/2 in. partition bypass piping connections shall be seamless grade TP 304L stainless steel, Schedule 40 pipe, manufactured and inspected according to ASTM Specification A-312.

9.8.4 Fabrication Requirements

The following drawings are applicable to an existing transfer line installation and have been selected and included in the appendix to provide additional guidance and clarification.

X-21255-EE-001-E	P-20013-EE-004-D
P-20013-EE-001-C	P-20013-EE-005-D
P-20012-EE-002-D	P-20013-EE-006-D
P-20013-EE-003-D	P-20013-EE-009-D

9.8.4.1 Welding

All welders shall be qualified according to ASME Boiler and Pressure Vessel Code, Section IX.

Weld procedures shall be according to ASME Boiler and Pressure Vessel Code, Section IX.

All welds on the inner pipe shall be fully radiographed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, paragraph UW-51.

All welds on the outer pipe shall be dye penetrant inspected after the root and final weld passes.

All welds shall be tested by means of a 5 psig gas pressure "soap bubble" test and all completed systems by means of a 4-hr 100 psig gas pressure "hold test."

9.8.4.2 Direction Changes for Contained Sections

All direction changes between 0° and 30° shall be made by means of wedge type partition plates.

All direction changes greater than 30° shall be made by use of fabricated bends having a minimum centerline radius of 72 in.

All pipe bend areas shall be 100% dye penetrant inspected following bending.

9.8.5 Installation Requirements for Double Pipe Construction

Precautions for welding shall be followed as set forth in ES-4.01 in Appendix.

Backfill shall be select clay from a minimum of 6 in. below the pipe line to a minimum of 12 in. above the pipe (remaining backfill may be carefully selected earth removed during trench excavation).

The entire length of all underground lines shall be cathodic protected.

The primary pipe line shall be hydrotested at 250 psig. No detectable leakage will be permitted.

9.9 Process Piping - API High Pressure Injection

Piping classified as high pressure injection piping shall include all piping which will be subjected to the discharge pressure from the Halliburton HT-400 pump heads. This piping is located in both the pump and the well cells and is to include all well head parts down to the first flange on the existing 9-1/2 in. surface casing. The high pressure injection piping valve manifold shall be isolated from vibration from pump heads and well head by means of swivel joints. These swivel joints shall be anchored to the cell floor to prevent whipping in case of rupture during operation. All high pressure valves shall have remote hydraulic actuated operators with manual over-ride for opening and a spring return for closure. All piping and valves shall have ring joint flanged connections. All piping that is subject to Halliburton HT-400 pump discharge pressure shall have a quality level of II as defined by HNL.

9.9.1 Codes and Standards

API Specification for Wellhead Equipment 6A
API Specification for Pipeline Valves 6D
API Specification for Threading, Gaging, and Thread Inspection 5B
API Specification for Casing, Tubing, and Drill Pipe 5A
American Iron and Steel Institute
API Specification 1104
ASME Boiler Code, Sections VIII and IX

9.9.2 Design Conditions

Maximum design temperature - 125°F
Minimum design temperature - 33°F
Design pressure - 10,000 psig

9.9.3 Materials of Construction

All fittings shall be open-flange flow fittings having a bore dimension of 2-1/16 in. and manufactured from AISI 4140 steel.

All piping flanges shall be API Type 6BX integral flanges for 10,000 psig operating pressure.

All gaskets shall be API Type BX 152 pressure energized ring-joint gaskets.

All wellhead fittings shall be constructed of AISI 4140 steel according to API Specification 6A.

The injection piping valves shall be flanged Lo-Torq 10,000 psig plug valves as manufactured by Halliburton Company, Duncan, Oklahoma.

The relief valve for the injection piping system shall be a 2-in. valve as manufactured by Baird Manufacturing Company, Tulsa, Oklahoma.

All check valves shall be flanged 2-in. check valves as manufactured by Halliburton Company, Duncan, Oklahoma.

Plug valve operators shall be Bettis Robotarums as manufactured by Bettis Manufacturing Company.

The equipment to be supplied for the injection well is listed below:

Tubing Head - 10,000 psi rating with 10-in. bottom and 7-1/16 in. top flange

Adaptor - BO-2 tubing head 10,000 psi rating with a 7-1/16 in. bottom and 2-9/16 in. top flange and having a BO-2 hanger coupling for 2-7/8 in. tubing.

Plug Container - shall match the adaptor above

Shut-off Valves - 2-1/2 in. flanged plug valve (1 required)
- 2 in. flanged plug valves (2 required)

Tubing String - 1000 ft of C-75 or N-80 External Upset tubing having 8 threads and weighing 6.5 lbs per ft.

The swivel joints shall be Style No. 10-EHP-Lg. sweep as manufactured by Chicksan Company.

The welding rod shall be P&H 4130 small diameter rod.

Bolting material shall be of quality and strength not less than Grade B7 ASTM A-193 or Grade BC ASTM A-354.

9.9.4 Fabrication Requirements

Welder qualification and welding shall be done in accordance with either ASME Boiler Code, Section IX or API Specification 1104.

Preheat and post-heat treatment is required for all welding performed on 4140 steel.

All welds on the high pressure injection piping and valves shall be full radiographed, according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, paragraph UW-51.

All valves and fabricated pipe sections shall be given a hydrostatic pressure test at 10,000 psig after fabrication.

9.10 Process Piping - Other Stainless Steel

All piping, other than the high pressure injection, located in the mixing cell, pump cell, well cell, and the emergency waste pit shall be 304L stainless steel purchased, and installed according to Quality Level III requirements.

9.10.1 Codes and Standards

ASME Pressure Vessel Code, Section II, VIII, and IX
ASTM Specifications
Power Piping Code, ANSI B 31.1

9.10.2 Design Conditions

Maximum design temperature - 125°F
Minimum design temperature - 33°F
Maximum design pressure - 150 psig

9.10.3 Materials of Construction

All pipe materials shall be Schedule 40, seamless grade TP 304L stainless steel pipe manufactured and inspected according to ASTM Specification A-312.

All piping shall be butt welded except where disconnects are required. All disconnects shall utilize 150 lb slip-on, 304L stainless steel flanges manufactured and inspected according to ASTM A-182.

Welding rod materials shall be ER 308L bare rod manufactured and inspected according to ASME Boiler and Pressure Vessel Code, Section II, Part C, Materials Specification SFA-5.9.

All valves in slurry handling lines shall be Keystone Valve Corporation Figure 99 having a 316L stainless steel body and disk-stem and a Buna N resilient seat or approved equal.

All valves in cells in non-slurry handling lines shall be 316 or 304 stainless steel ball valves as manufactured by Worcester Valve Company, Worcester, Massachusetts, or approved equal.

Cold bending of pipe shall be used instead of fittings wherever possible. Where fittings are required they shall be 304L stainless butt welded manufactured and inspected according to ASTM A-403.

9.10.4 Fabrication Requirements (Reference Drawing - X-21255-EE-001-E)

9.10.4.1 Welding

All welders shall be qualified according to the ASME Boiler and Pressure Vessel Code, Section IX.

Weld procedures shall be according to ASME Boiler Code, Section IX.

All welds shall be fully radiographed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, paragraph UW-51.

The suction connection to the waste injection pump shall be isolated from vibration by the addition of a 5-ft section of hose. The hose shall be Gates 100 SB 5-in. ID with 5-in. KC type nipples at each end or approved equal.

9.11 Process and Radiation Monitoring Instrumentation

Process and control instrumentation requirements are indicated on the conceptual instrument engineering flowsheet, Dwg. No. X-21225-QE-001-D. Panel-mounted instruments are denoted by circle symbols with a horizontal line through the center. Plain circles denote field-mounted instruments.

A raised operating platform will be provided in the control room to allow operators to view in-cell mixing operations directly through shielded viewing windows as they remotely manipulate pumps, valves, etc. A graphic control panel will be installed adjacent to and in convenient reach of this platform. The proposed layout for this graphic panel is shown on Dwg. No. X-21225-QE-002-D. Generally, pneumatic transmission signals will be used for instruments, including operators for remote valves.

Radiation monitoring instrumentation will be installed for the protection of personnel.

9.11.1 Codes and Standards

Instrument symbols and identifications used on control diagram and instrument tabulations are in accordance with ISA Standard S5.1.

Copper tubing shall be in accordance with ASTM Specification B280.

Stainless steel tubing shall be in accordance with ASTM Specification A269.

Plastic tubing shall be Samuel Moore and Company "Dekoron P" or equal.

Thermocouple wire and extension wire shall be in accordance with Instrument Society of America RP-1.

9.11.2 Process Systems

(1) Waste Storage Facility. (Tanks W-23 and W-24) Existing (see ORNL-TM-4455) liquid level and temperature readouts, pump controls, and alarm annuciations, presently located on the Building 7825 control panel, will be installed in parallel on the new hydrofracture control panel.
Alarms will be telemetered to the waste monitoring building, Building 3105, in the main plant area as indicated on the control diagram.
See Table 9.12 for a detailed tabulation of instrumentation to be included in project.

(2) Dry, Solid Storage, Blending, and Mixing Vessel Levels. It is proposed that the solids level in vessels containing dry solids be sensed with a variable resistance element, such as "Metritape," and a resistance-bridge indicator.

(3) Slotting Waste Tank Level. Tank level will be sensed with an air-purged differential pressure transmitter. A process water source will be connected to these purge lines for use in periodic cleaning of sensing probes.

9.11.3 Radiation Monitoring Systems

A hand-and-foot counter and manual probes will be installed for checking hands, shoes, and clothing for radioactive contamination. Constant air monitors and radiation monitors will be installed for the detection of airborne releases and excessive radiation levels within operating areas.

9.11.4 Material and Fabrication Requirements

Thermocouples shall be chromel-alumel encased in a 1/8 in. OD stainless steel sheath with magnesium oxide insulation.

Thermocouple extension wire shall be chromel-alumel type stranded wire with polyvinyl insulation and outer covering.

Instrument wiring in cells, pump pits, and valve pits shall be contained in a weatherproof 304 stainless conduit.

Thermocouple and instrument signal wiring shall be contained in wireways or conduits separate from any wires which conduct 60 cycle alternating current.

All wiring shall be labeled at each terminal point to facilitate installation and subsequent troubleshooting. Labeling shall coincide with wiring diagrams and electrical schematic drawings.

Pneumatic instrument lines shall be 304 stainless within cells and pits, plastic behind main panel boards, and coated or uncoated copper or aluminum as appropriate for other locations.

Pneumatic instrument lines from transmitters to process vessels or lines shall be installed so that any accumulation of moisture will drain into the process. Low points or pockets are to be avoided.

Transmitters shall be mounted higher in elevation than the place in the process piping where the tie-in occurs. This is done so that the preceding requirement is possible.

Instrument quality shall equal or exceed that of manufacturers' products listed below:

Differential pressure transmitters	Foxboro 13A/15A
Pneumatic, miniature recorders	Foxboro M53
Pneumatic controllers	Foxboro M58
Remotely operated ball valves	Worcester 34AN-466T
Annunciator	Ronan X2-1050
Solenoid valves	Skinner Elect. V5 Series
Pressure switches	Honeywell L604A1094
Amplifier/relay/conductivity	Honeywell Versa-Tran.
Thermocouples	Thermoelectric Ceramo
Liquid level transmitter, plummet type	FIC Industries No. 1121-1133

Specific instrument requirements are as follows:

Instrument No.	Function	Description	No. Req'd.	Range
LI-T4	Vessel BST-1 Level Element	Resistance Bridge Indicator	1	0-100%
LI-T5*	Vessel BST-1 Level Element	Resistance Bridge Indicator	1	0-100%
LI-T6	Vessel BST-1 Level Element	Resistance Bridge Indicator	1	0-100%
LT-T7	Slotting Waste Collection Tank Level Transmitter	Purged Differential Press. Trans.	1	0-100%
LI-T7	Slotting Waste Collection Tank Level Indicator	Vertical Scale Pressure Receiver	1	3-15 psig
LT-S1*	Sump S-1 Level Transmitter			
LI-S1	Sump S-1 Level Indicator			
FE-45	Feed Hopper BST-6 Effluent Flow Element	Force (Impact) Sensor	1	
FT-45	Feed Hopper BST-6 Effluent Flow Transmitter	Force Transmitter	1	
FR-45	Feed Hopper BST-6 Effluent Flow Recorder			
FC-45	Feed Hopper BST-6 Effluent Flow Controller			
FCV-45	Feed Hopper BST-6 Effluent Flow Control Valve			
PI-110	Pump P-3 Discharge Pressure	Pressure Indicator	1	
PI-111	Pump P-3 Discharge Pressure	Pressure Indicator	1	
PI-112	Well Head Annulus Pressure	Pressure Indicator	1	
PI-113	Well Head Annulus Pressure	Pressure Indicator	1	
HS-P1, P2, P3, P4, P5, P6, P8, M1, M2	Pump or Agitator Motor Start-Stop Switch	Two-position Spring Return Switch	9	115 VAC
HS-1, etc.	Remote Actuation of Block Valves	Manual Pneumatic Toggle Valve, On-Off	27	
SICS-P1*	Speed Indicating Control Station for Pump P-1	Remote Manual Loading Station, Foxboro 135T	1	3-15 psig
SZ-P1	Pneumatic Speed Regulator on Pump P-1	Integral with Pump	1	3-15 psig
SICS-P2	Pneumatic Speed Regulator on Pump P-2	Integral with Pump	1	3-15 psig
SZ-P2	Pneumatic Speed Regulator on Pump P-2	Integral with Pump	1	3-15 psig
SICS-P5	Pneumatic Speed Regulator on Pump P-5	Integral with Pump	1	3-15 psig
SZ-P5	Pneumatic Speed Regulator on Pump P-5	Integral with Pump	1	3-15 psig
SICS-P6	Pneumatic Speed Regulator on Pump P-6	Integral with Pump	1	3-15 psig
SZ-P6	Pneumatic Speed Regulator on Pump P-6	Integral with Pump	1	3-15 psig
SICS-P8	Pneumatic Speed Regulator on Pump P-8	Integral with Pump	1	3-15 psig
SZ-P8	Pneumatic Speed Regulator on Pump P-8	Integral with Pump	1	3-15 psig
PI-P1A	20 psig Air to Pump P-1	Pressure Indicator	1	0-30 psig
PI-P1B	20 psig Air to Pump P-1	Pressure Indicator	1	0-30 psig
PI-P2A	20 psig Air to Pump P-2	Pressure Indicator	1	0-30 psig
PI-P2B	20 psig Air to Pump P-2	Pressure Indicator	1	0-30 psig
LE-T1	Vessel BST-1 Level Element	"Metritape" Variable Resistance Element	1	0-30 psig
LI-T1	Vessel BST-1 Level Element	Resistance Bridge Indicator	1	0-100%
LI-T2	Vessel BST-1 Level Element	Resistance Bridge Indicator	1	0-100%
LI-T3	Vessel BST-1 Level Element	Resistance Bridge Indicator	1	0-100%

*Panel-mounted instrument.

9.12 Electrical

9.12.1 Codes and Standards

The electrical materials and workmanship shall comply to the following Codes and Standards:

National Electric Code

National Electrical Manufacturers' Association

American National Standards Institute

Institute of Electrical and Electronics Engineers

Underwriters' Laboratories, Inc.

ERDA General Design Criteria, Manual Appendix 6301

National Fire Protection Association

IPCEA Standards

Illuminating Engineering Society

NACE Standard RP-01-69, Recommended Practice - Control of External Corrosion on Underground or Submerged Metallic Piping Systems

Minimum Safety Requirements, ERDA Manual, Chapter 0550

9.12.2 Schematic Device Identification & Conductor Numbering

Electrical schematic conductor numbering and device identification shall be as shown in ORNL Publication No. 60-10-62, "Electrical Design Standards and Graphical Symbols."

9.12.3 Outside Utilities (Drawing X-21255-ED-001-D)

(1) Distribution. 480 volt load distribution feeders shall be routed underground in rigid conduits from the load control and circuit protection devices to be installed in existing substation near W23 and W24 tanks to: the main distribution panel within the new hydrofracture building; the main distribution panel within the control building at the waste storage area; the compressors; and to the fuller Kinyon pumps.

(2) Lighting. Outside area lighting shall be provided for the solids storage and blend area, the emergency waste pond, the liquid waste storage area, and the parking area. Control of outside

lights shall be manual. Lighting system service conductors shall be routed overhead.

(3) Fire Alarm. The 100 mA Gamewell fire alarm loop shall be extended from the existing hydrofracture facility to the new site. 4/C No. 12 AWG solid conductor aerial cable shall be used and shall be supported on messenger wire mounted on the existing power poles. Lightning arresters shall be supplied at terminal poles. The cable shall continue in conduit underground from the terminal pole to the storage facility and the New Hydrofracture Facility.

(4) Telephone. A 2 in. conduit with nylon pull cable shall be installed underground from the existing overhead electrical power dead-end structure to the telephone cabinet within the new hydrofracture building.

9.12.4 Hydrofracture Building (Drawing X-21255-ED-001-D)

(1) Distribution. The main 480 volt distribution panel shall be located within the compressor room. This panel shall contain the breakers for circuit protection of the building service equipment and smaller pumps and agitators. Motor starters and heater contactors shall be located near the served equipment. All wiring shall be installed in rigid steel or rigid aluminum conduit or electric metallic tubing. All conduits shall be exposed where practical. Control stations for the motors shall be located on a separate panel within the control room and shall consist of start-stop push buttons and red and green pilot lights. All controls are to be 120 volt ac 60 Hertz. A dry-type transformer shall be supplied and conveniently located to supply power for the lights, receptacles, and miscellaneous equipment. Circuit breaker type lighting and receptacle panels shall be supplied as required. All panels and low voltage transformers shall have 20% spare capacity and lighting and receptacle panels shall be provided with 25% spare 20 amp breakers.

(2) Lighting. Fluorescent lighting shall be used throughout the building except for exit lights, emergency lights, cell access

corridor lighting, and cell room lighting. Self-charging battery powered units shall be provided for all exit and emergency lights. Incandescent lighting shall be used for the cell access corridor, well cell and the pump cells. The lighting for the mixing cell shall be by 400 watt mercury vapor bulbs. The control room and office area shall have an illumination level of 50 foot-candles. The light transmission quality of the mixing cell lead glass windows shall be checked and lights installed within the cell to provide 50 foot-candles at control room side of windows; also, 50% spare fixtures on a separate switch shall be provided within the mixing cell to allow for burnout. In addition, an incandescent lighting system designed to 50 foot-candles (in cell illumination) shall be provided for in-cell maintenance. Weather protected incandescent, bracket type fixtures shall be located to illuminate exit paths from building including the cell access corridor. These emergency units shall operate automatically upon power failure.

(3) Receptacles. 120 volt, single phase, 3 wire, 3 pole receptacles (Hubbell No. 5242 or approved equal) shall be located a maximum of 12 ft around walls in all building areas and on 6-ft centers in the mixing cell. Six 220 volt, single phase, 20 amp, 3 pole, 3 wire receptacles shall be located within the mixing cell. Provide a minimum of three 480 volt, three phase, 60 amp welding receptacles throughout the building.

(4) Communications. A location shall be designated for the Bell Telephone Company's main telephone cabinet. The incoming conduits shall be terminated at this point and an empty communications conduit system with No. 14 iron fish wire shall be provided with outlet boxes installed within the control room, office, tool stores, compressor room, mixing cell, pump cells, well cell, pump rooms, cell access corridor, and a minimum of one 1 in. conduit shall be routed to the north and south building exteriors for PA system speakers. All communication conductors and communication equipment shall be furnished and

installed by South Central Bell after construction of the building has been completed.

(5) Fire Alarm System. A complete shunt type auxiliary fire alarm system shall be installed within the New Hydrofracture Facility. The system shall include Gamewell three-fold succession non-interfering master shunt type fire alarm box (No. 9000), light type annunciator, manual pull boxes, dual alarm control panel, a system of AC evacuation horns, and all connecting wiring and conduits. The master box code wheel shall be supplied by the Company. The system shall be a supervisory system conforming to the requirements of NFPA 72-B.

(6) Grounding. All electrical systems shall be grounded in strict accordance with the rigid requirements contained in the National Electrical Code. Specific methods for grounding shall be detailed and specified on the drawings. Tests shall be specified to demonstrate the adequacy of the grounding system.

9.12.5 Waste Transfer Lines

Cathodic protection shall be provided for all directly buried stainless steel waste transfer lines. If practical, an externally applied impressed current system shall be provided. The cathodic protection shall be installed concurrent with the installation of the stainless steel, and protective current shall be applied immediately after placement of pipe in the earth. The rectifier anode bed system shall be capable of maintaining the pipeline at a negative voltage of 0.85 volts relative to a Cu-$CuSO_4$ reference electrode for a 25-yr design life. Complete installation instructions and details shall be provided.

10.0 MASTER LIST

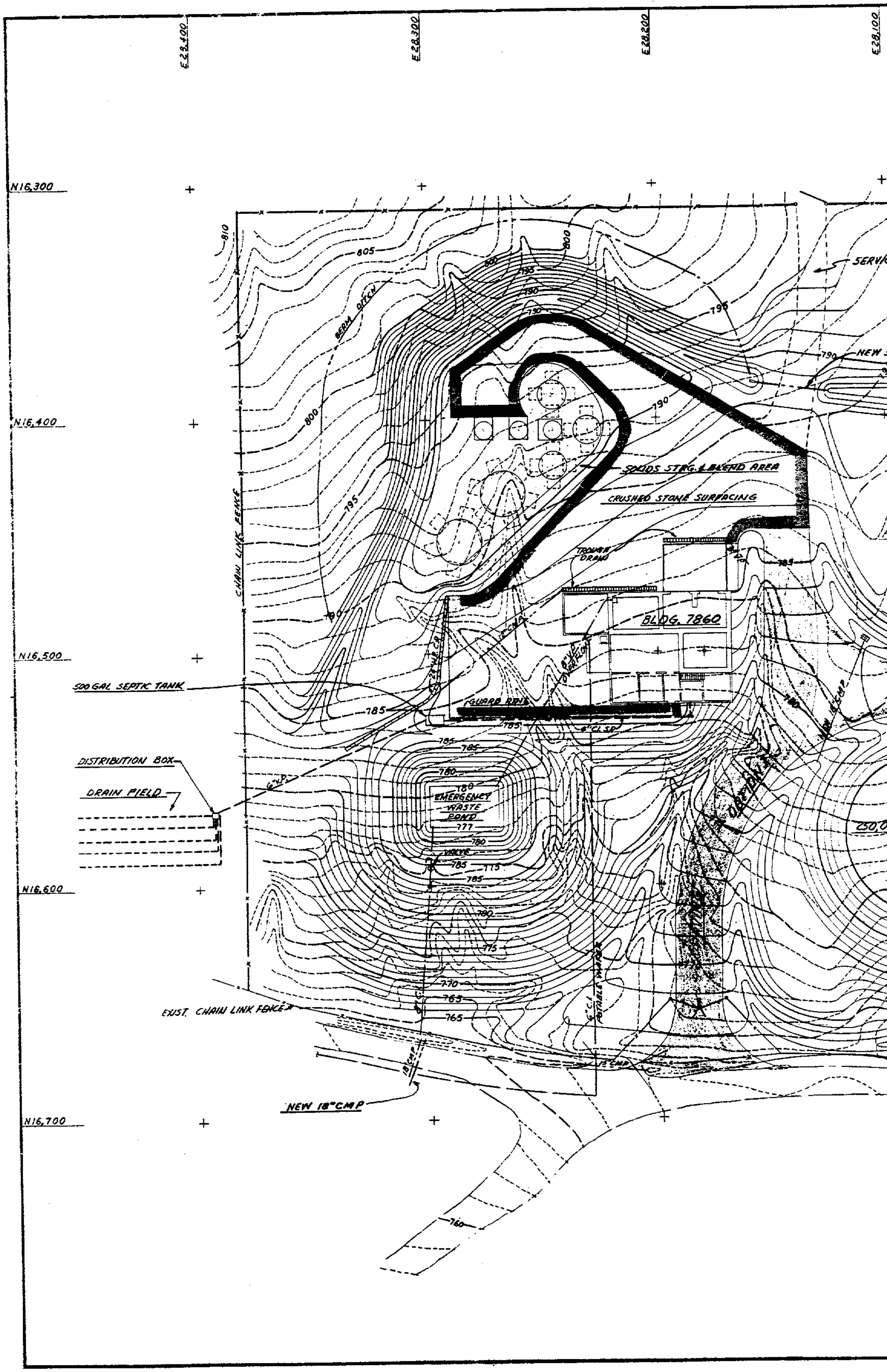
Equipment No.	Drawing No.	Description	Design	Procure	Install
Building Equipment					
	X-21255-EB-003-D	8 Ton Elec. Trolley Hoist	AE	LSC	LSC
	X-21255-EG-001-D	Cell Ventilation Blower	AE	LSC	LSC
	X-21255-EG-001-D	Cell Ventilation Filter Units	AE	LSC	LSC
	X-21255-EG-001-D	Off-Gas Blower	AE	LSC	LSC
	X-21255-EG-001-D	Off-Gas Filter Units	AE	LSC	LSC
	X-21255-EG-001-D	Change Room Exhaust Fan	AE	LSC	LSC
	X-21255-EG-001-D	Toilet Exhaust Fan	AE	LSC	LSC
		Reduced Pressure Principal Backflow Preventer	AE	LSC	LSC
		Drinking Fountain	AE	LSC	LSC
		Potable Water Heater	AE	LSC	LSC
	X-21255-EG-001-D	Circulating Heater	AE	LSC	LSC
	X-21255-EG-001-D	Through the Wall AC Unit	AE	LSC	LSC
	X-21255-EG-001-D	Roof Top AC Unit	AE	LSC	LSC
		Shielding Windows	AE	LSC	LSC
Solids Handling Equipment					
BST-4	X-21255-EE-001-D	Blend Bulk Storage Tank	Vendor	UCCND	Vendor
BST-5	X-21255-EE-001-D	Blend Bulk Storage Tank	Vendor	UCCND	Vendor
BST-6	X-21255-EE-001-D	Feed Hopper	Vendor	UCCND	Vendor

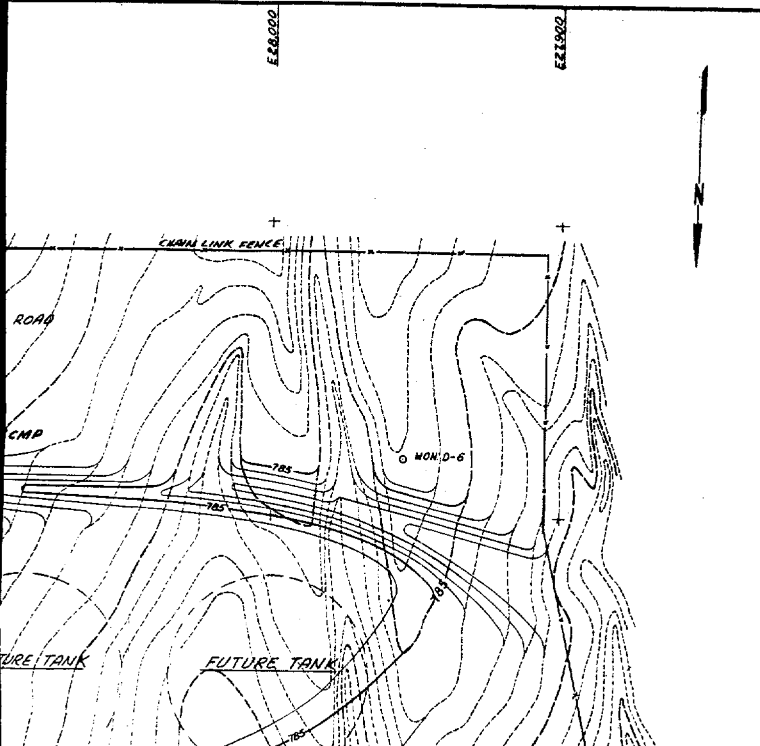
Equipment No.	Drawing No.	Description	Design	Procure	Install
B-1	X-21255-EE-001-D	Bag Filter	Existing		CPFF
B-2	X-21255-EE-001-D	Bag Filter	Vendor	UCCND	Vendor
P-1	X-21255-EE-001-D	Solid Fluidizer Pump	Vendor	UCCND	Vendor
P-2	X-21255-EE-001-D	Solid Fluidizer Pump	Vendor	UCCND	Vendor
BST-1	X-21255-EE-001-D	Attapulgite Storage	Existing		CPFF
BST-2	X-21255-EE-001-D	Attapulgite Storage	Existing		CPFF
BST-3	X-21255-EE-001-D	Potter's Clay Storage	Existing		CPFF
	X-21255-EE-001-D	Air Slides	Existing		CPFF
	X-21255-EE-001-D	Scale Tank	Existing		CPFF
	X-21255-EE-001-D	Blending Tank	Existing		CPFF
	X-21255-EE-001-D	Blending Tank	Existing		CPFF
B-3	X-21255-EE-001-D	Bag Filter	Vendor	UCCND	Vendor
Process Equipment					
	X-21255-EE-001-D	Slotting Waste Tank	UCCND	UCCND	CPFF
	X-21255-EE-002-D	Well Head Fittings	UCCND	UCCND	Vendor
P-3	X-21255-EE-001-D	Injection Pump	UCCND	UCCND	CPFF
P-4	X-21255-EE-001-D	Standby Pump	Existing		CPFF
	X-21255-EE-001-D	Mixing Tub	UCCND	UCCND	CPFF
	X-21255-EE-001-D	Mixing Hopper	UCCND	UCCND	CPFF
	X-21255-EE-001-D	Mixing Jet	UCCND	UCCND	CPFF
	X-21255-EE-001-D	Mass Flow Meter	UCCND	UCCND	CPFF
		2 Shielding Windows	UCCND	UCCND	CPFF

Equipment No.	Drawing No.	Description	Design	Procure	Install
P-8	X-21255-EE-001-D	Slotting Waste Pump	UCCND	UCCND	CPFF
M-1	X-21255-EE-001-D	Mixing Tub Agitator	UCCND	UCCND	CPFF
M-2	X-21255-EE-001-D	Slotting Waste Tank Agitator	UCCND	UCCND	CPFF
P-7	X-21255-EE-001-D	TBP Injection Pump	UCCND	UCCND	CPFF
P-9	X-21255-EE-001-D	Mixing Cell Sump Pump	UCCND	UCCND	CPFF
P-10	X-21255-EE-001-D	Vault Sump Pump	UCCND	UCCND	CPFF
Service Equipment Process					
	X-21255-EE-001-D	30 psi Air Compressor	Vendor	LSC	LSC
	X-21255-EE-001-D	5 psi Air Compressor	Vendor	LSC	LSC
	X-21255-EE-001-D	100 psi Air Compressor	Vendor	LSC	LSC
	X-21255-EE-001-D	100 psi Air Dryer	Vendor	LSC	LSC
Instrumentation					
	X-21255-QE-001-D-1	Process Instrumentation	UCCND	UCCND	CPFF
	X-21255-QE-002-D-0	Instrument Panel Board	UCCND	UCCND	CPFF
		Radiation Monitoring Instrumentation	UCCND	UCCND	CPFF

10.0 Conceptual Drawing List

Drawing	Title
X-21255-EA-001-E	Grading Plan
X-21255-EA-004-D	Conceptual Design Showing Existing and New Monument, Observation, and Rock Wells
X-21247-EA-005-E	Site Topograph and Subsurface Data for Conceptual Design
X-21255-EB-001-D	Basement and First Floor Plan
X-21255-EB-002-D	Roof Plan
X-21255-EB-003-D	Sections
X-21255-EB-004-D	Door and Room Finish Schedule
X-21255-EE-001-E	Process and Service Engineering Flow Sheet
X-21255-EE-002-D	Injection and Monitoring Well Configuration
X-21255-EE-003-D	Cell Process and Service Piping Plan
X-21255-EG-001-D	Air Handling Schematic
X-21255-ED-001-D	Electrical One-Line Diagram
X-21255-QE-001-D-1	Process Instrumentation
X-21255-QE-002-D-0	Instrument Panel Board


E28,400
E28,300
E28,200
E28,100
N16,300
N16,400
N16,500
N16,600
N16,700
BERM DITCH
CHAIN LINK FENCE
SOLIDS STRG. & BLEND AREA
CRUSHED STONE SURFACING
TRENCH DRAIN
BLDG. 7860
500 GAL SEPTIC TANK
GUARD RAIL
DISTRIBUTION BOX
DRAIN FIELD
EMERGENCY WASTE POND
VALVE
EXIST. CHAIN LINK FENCE
NEW 18" CMP
POTABLE WATER



Note:
FOR UPDATED CONTOURS
SEE DWG. X-21247-EA-005-E

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TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: 1" = 20'

NO.	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
R.H. Petree	4-73	R.E. [illegible]	2-5-75		
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
		R.W. Holmes	2-5-75		
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
				[illegible]	2-10-75

REFERENCE DRAWINGS	NUMBER

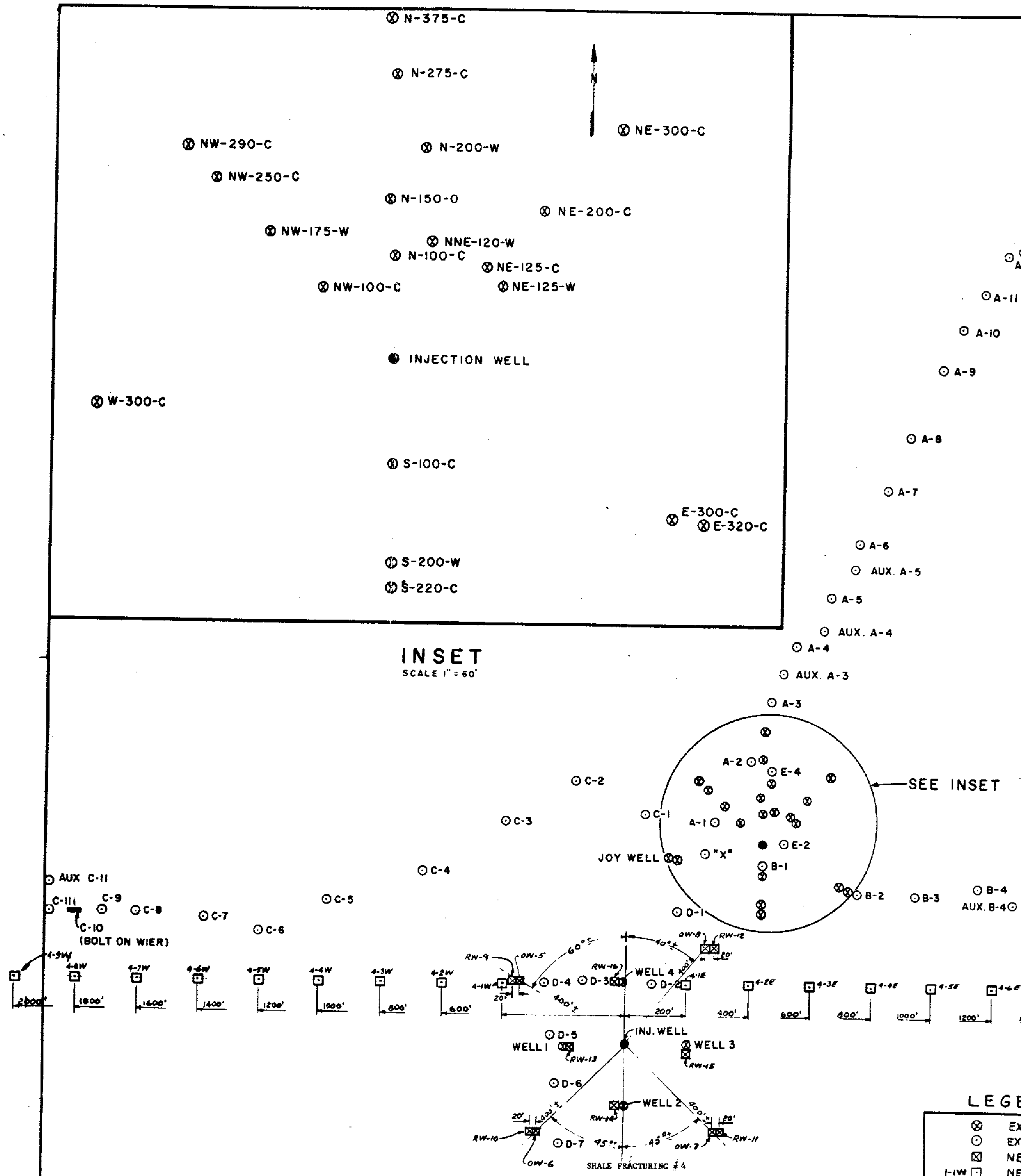
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

NEW HYDROFRACTURE CONCEPTUAL DES. BLDG. NO. 7860

GRADING PLAN

SUBMITTED	ACCEPTED	APPROVED
L.M. Carter	R.A. [illegible]	J.W. [illegible]

H.O. BAKER | X | 27255 | EA | 001 | [illegible]



NO.	COORDINATES		ELEV.	DESCRIPTION
INJ. WELL	N. 16,502.67	E. 28,178.54	788.91	TOP OF COUPLING
1	N. 16,502.09	E. 27,978.14	782.48	TOP OF COUPLING
2	N. 16,304.18	E. 28,179.01	799.12	TOP OF COUPLING
3	N. 16,503.14	E. 28,377.88	787.99	TOP OF COUPLING
4	N. 16,702.33	E. 28,178.13	771.15	TOP OF COUPLING

NO.	REVISIONS			DATE	APPD	APPD
DRAWN A.H. PETREE	DATE 10-74	SUBMITTED R.E. Lampton	DATE 10/3/74	APPROVED	DATE	
DESIGNED	DATE	APPROVED RM Holmes	DATE 10/1/74	APPROVED	DATE	
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE 2-10-75	

NOTE: NEW MONU
ATED ADJACENT
ROADWAY AT APPR
INDICATED (TO BE
BY ELEVATIONAL

N-375-C	N17,521.91	E28,607.63	772.00 Top of Coupling
NW-290-C	N17,358.09	E28,412.08	759.48 Top of Coupling
W-300-C	N17,108.52	E28,327.11	761.18 Top of Coupling
S-200-W	N16,953.80	E28,618.83	761.86 Top of Coupling
S-220-C	N16,933.70	E28,618.88	761.46 Top of Coupling
NE-300-C	N17,377.62	E28,839.25	815.83 Top of Coupling
E-300-C	N17,003.06	E28,892.96	783.27 Top of Coupling
E-32?-C	N16,948.59	E28,923.74	781.99 Top of Coupling

Well N-375-C is not plotted to scale.

. A-12

MONUMENT	COORDINATES	
A-10	N 18,833.05	E 29,249.70
A-11	N 18,951.66	E 29.321.44
A-12	N 19,082.08	E 29,395.05
AUX.A-12	N 19,091.81	E 29,437.52
C-9	N 16,929.68	E 26,425.22
C-10	N 16,902.14	E 26,265.77
C-11	N 16,884.14	E 26,089.13
AUX.C-11	N 16,861.96	E 26,013.48

NOTE: MONUMENTS C-9, C-10, C-11, AND AUX.C-11 ARE NOT PLOTTED TO SCALE.

SHALE FRACTURING EXPERIMENT #2 AND #3 MONUMENT COORDINATES AND BEARINGS

EXPERIMENT #2

MONUMENT	COORDINATES		BEARING
HFIR #1	N16,949.60	E32,148.12	N 00° 03' 19" E
HFIR #3	N17,199.60	E32,148.36	N 83° 56' 41" W
3-E	N17,220.78	E31,948.68	S 59° 55' 56" W
2-E	N17,020.59	E31,602.89	S 59° 22' 41" W
1-E	N16,918.45	E31,430.32	S 30° 41' 26" W
1-F	N16,792.23	E31,355.40	N 75° 41' 02" W *
1-B	N16,841.56	E31,162.10	N 75° 38' 54" W
3-B	N16,891.20	E30,968.09	N 75° 31' 14" W
5-B	N16,966.24	E30,677.52	N 75° 41' 14" W
6-B	N16,990.97	E30,580.59	

EXPERIMENT #3

MONUMENT	COORDINATES		BEARING
A-1	N17,226.39	E28,467.64	N 29° 36' 26" E
A-2	N17,424.31	E28,580.11	N 18° 56' 46" E
A-3	N17,616.26	E28,646.01	N 23° 14' 56" E
A-4	N17,795.23	E28,722.90	N 34° 24' 46" E
A-5	N17,953.72	E28,831.47	N 27° 55' 26" E
A-6	N18,128.08	E28,923.89	N 27° 32' 26" E
A-7	N18,300.98	E29,014.06	N 23° 54' 46" E
A-8	N18,473.44	E29,090.54	N 23° 46' 06" E
A-9	N18,696.62	E29,188.83	
B-1	N17,085.73	E28,621.05	S 73° 44' 46" E
B-2	N16,995.30	E28,931.23	S 88° 39' 26" E
B-3	N16,[illegible].77	E29,124.58	N 82° 03' 34" E
B-4	N17,019.49	E29,330.51	S 82° 48' 06" E
B-5	N16,990.47	E29,560.28	S 72° 02' 06" E
CD-115	N16,936.21	E29,727.61	N 30° 44' 04" E
B-6	N16,949.40	E29,308.46	N 79° 34' 44" E
B-7	N16,977.07	E29,958.91	N 81° 39' 36" E
B-8	N17,007.93	E30,169.44	N 78° 21' 21" E
B-9	N17,056.53	E30,405.25	

EXPERIMENT #3

MONUMENT	COORDINATES		BEARING
"X"	N17,121.02	E28,435.71	N 56° 16' 05" W *
C-1	N17,249.43	E28,243.40	N 64° 52' 56" W
C-2	N17,355.26	E28,017.65	S 59° 41' 14" W *
C-3	N17,223.24	E27,791.84	S 53° 06' 43" W *
C-4	N17,059.94	E27,514.25	S 72° 16' 18" W *
C-5	N16, 962.24	E27,208.64	S 64° 53' 54" W *
C-6	N16,858.01	E26,986.15	N 76° 25' 44" W
C-7	N16,901.21	E26,807.19	N 86° 45' 09" W
C-8	N16,913.73	E26,586.56	
D-1	N16,934.87	E28,348.96	S 18° 21' 30" W
D-2	N16,699.72	E28,270.93	N 86° 33' 32" W
D-3	N16,713.27	E28,065.71	S 85° 20' 49" W
D-4	N16,703.07	E27,920.34	S 06° 08' 56" E
D-5	N16,534.03	E27,938.55	S 05° 40' 16" E
D-6	N16,380.99	E27,953.75	S 04° 43' 36" E
D-7	N16,186.07	E27,969.87	
A-2	N17,424.31	E28,580.11	S 64° 38' 34" E
E-4	N17,392.74	E28,646.42	
B-1	N17,085.73	E28,621.05	N 42° 53' 14" E
B-2	N17,157.14	E28,687.38	

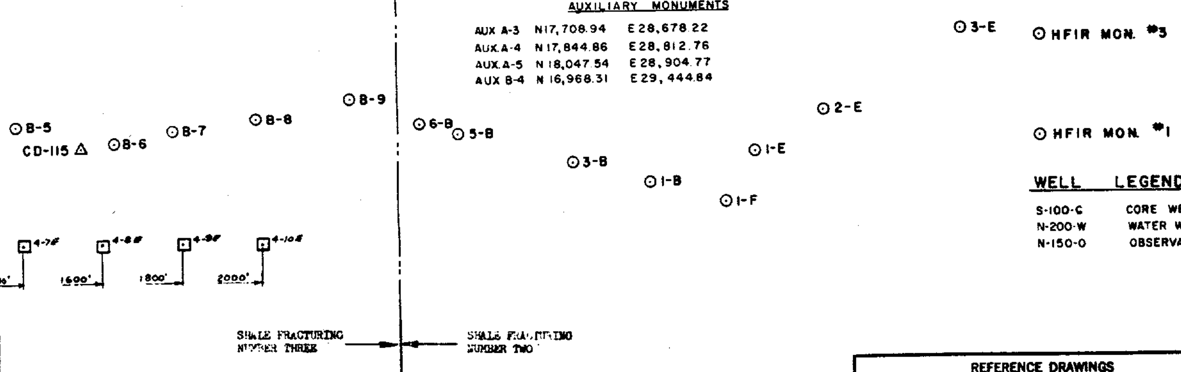
* Computed Bearing

SHALE FRACTURING EXPERIMENT #3 WELLS

NUMBER	COORDINATES		ELEVATION	
Injection Well	N17,255.03	E28,617.10	791.81	Top of Bottom Flange
S-100-C	N17,054.69	E28,617.94	786.12	Top of Coupling
N-100-C	N17,255.11	E28,617.35	786.34	Top of Coupling
N-150-O	N17,310.09	E28,611.51	786.45	Top of Tag
N-200-W	N17,359.78	E28,645.97	791.86	Top of Coupling
N-275-C	N17,430.09	E28,616.27	777.06	Top of Coupling
NW-100-C	N17,224.26	E28,547.46	777.81	Top of Coupling
NW-175-W	N17,278.35	E28,494.22	772.06	Top of Coupling
NW-250-C	N17,330.22	E28,440.63	759.68	Top of Coupling
NE-125-C	N17,245.08	E28,707.83	800.64	Top of Coupling
NE-125-W	N17,226.87	E28,723.34	800.23	Top of Coupling
NE-200-C	N17,299.45	E28,761.73	806.50	Top of Coupling
NNE-120-W	N17,269.40	E28,654.00	792.67	Top of Coupling
Joy Well	N17,115.00	E28,317.00	760.96	Top of Casing

AUXILIARY MONUMENTS

AUX A-3	N17,708.94	E28,678.22
AUX.A-4	N17,844.86	E28,812.76
AUX.A-5	N18,047.54	E28,904.77
AUX B-4	N16,968.31	E29,444.84



WELL LEGEND

S-100-C	CORE WELL
N-200-W	WATER WELL
N-150-O	OBSERVATION WELL

N D

STING WELL
STING MONUMENT
W WELL
W MONUMENT & NO.
K WELL & NO.
ERVATION WELL & NO.

MENTS ARE TO BE LO-
D EXISTING EAST-WEST
XIMATE DISTANCES
DETERMINED IN FIELD
DIFFERERENCES).

No representation or warranty, expressed or implied, is made that the use or disclosure of any information, apparatus, method or process disclosed in these drawings may not infringe private rights of others. No liability is assumed with respect to the use of or for damages resulting from the use of, any information, apparatus, method or process disclosed in these drawings. The drawings are being made available for information to bidder and are not to be used for other purposes, and are to be returned upon request of the forwarding contractor.

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±

SCALE: 1"=200' EXCEPT AS NOTED

REFERENCE DRAWINGS | NO.

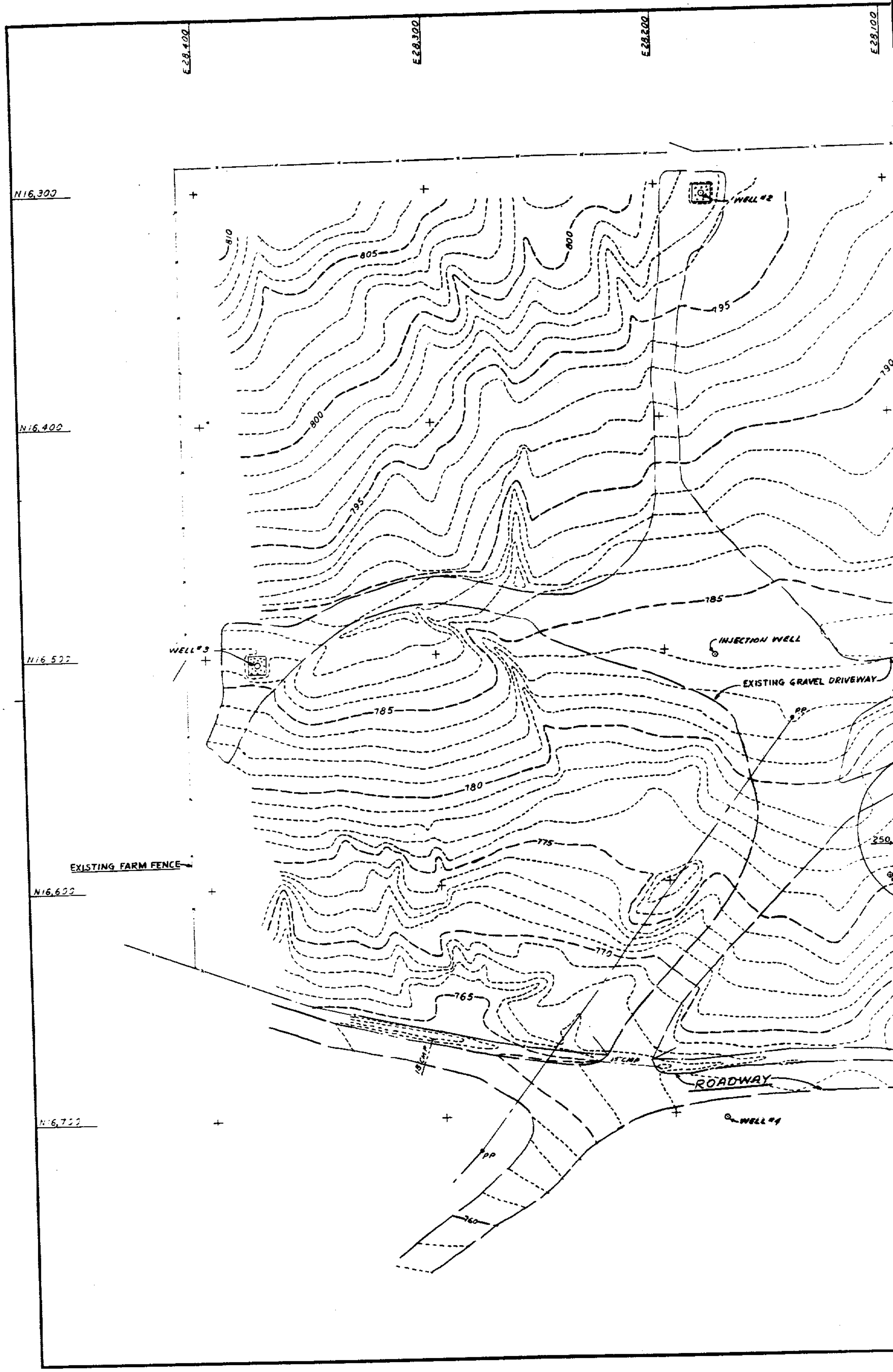
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

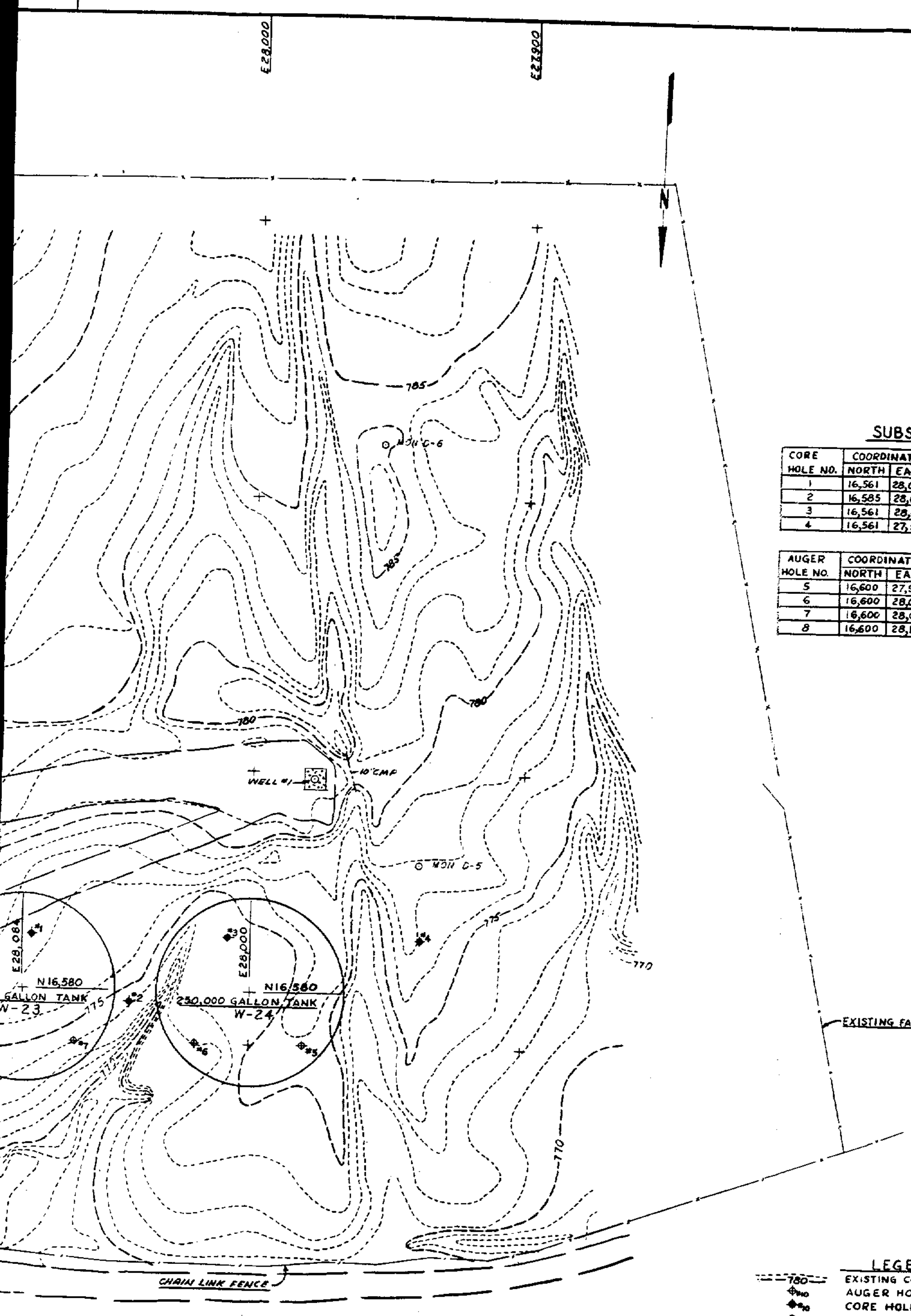
NEW HYDROFRACTURE FACILITY — BLDG. NO. 7860

CONCEPTUAL DESIGN SHOWING EXISTING AND NEW MONUMENTS, OBSERVATION & ROCK WELLS

SUBMITTED: C. W. Carter — APPROVED: R. A. Robinson — APPROVED: J. W. Ranford
APPROVED: H. O. BAKER

X-21255 EA 004 D REV.


E28,400
E28,300
E28,200
E28,100
N16,300
N16,400
N16,500
N16,600
N16,700
WELL #2
WELL #3
WELL #4
INJECTION WELL
EXISTING GRAVEL DRIVEWAY
EXISTING FARM FENCE
ROADWAY
810
805
800
795
790
785
780
775
770
765
760
PP
15" CMP



SUBSURFACE DATA

CORE HOLE NO.	COORDINATES NORTH	COORDINATES EAST	GROUND ELEV.	ROCK ELEV.	BOT. HOLE ELEV.	APPROX. WATER ELEV.
1	16,561	28,080	780.1	767.1	748.3	769.1
2	16,585	28,044	774.1	765.6	743.1	768.1
3	16,561	28,008	774.5	764.9	740.8	768.9
4	16,561	27,938	776.6	764.6	745.6	769.3

AUGER HOLE NO.	COORDINATES NORTH	COORDINATES EAST	GROUND ELEV.	REFUSAL ELEV.	APPROX. WATER ELEV.
5	16,600	27,980	775.0	767.4	768.2
6	16,600	28,020	775.8	766.0	768.0
7	16,600	28,064	774.3	766.5	768.0
8	16,600	28,104	775.0	767.7	769.7

LEGEND

- 780 — EXISTING CONTOURS
- #10 — AUGER HOLE LOCATION & NUMBER
- #10 — CORE HOLE LOCATION & NUMBER
- MON D-10 — SURVEYING MONUMENT & NUMBER

APPROVED

J. T. MILLOWAY 11-13-74
AEC DATE

J. L. Hanson 11-13-74
UCC-ND DATE

AE DATE

NO REPRESENTATION OR WARRANTY, EXPRESSED OR IMPLIED, IS MADE THAT THE USE OR DISCLOSURE OF ANY INFORMATION, APPARATUS, METHOD OR PROCESS DISCLOSED IN THESE DRAWINGS MAY NOT INFRINGE PRIVATE RIGHTS OF OTHERS. NO LIABILITY IS ASSUMED WITH RESPECT TO THE USE OF, OR FOR DAMAGES RESULTING FROM THE USE OF, ANY INFORMATION, APPARATUS, METHOD OR PROCESS DISCLOSED IN THESE DRAWINGS. THE DRAWINGS ARE BEING MADE AVAILABLE FOR INFORMATION TO BIDDER AND ARE NOT TO BE USED FOR OTHER PURPOSES, AND ARE TO BE RETURNED UPON REQUEST OF THE FORWARDING CONTRACTOR.

TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: 1" = 20'

NO.	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
A.H. Petrey	10-74	R.E. Lampton	11-13-74		
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
		R.M. Holmes	11-9/74		
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
R.M. Holmes	10-74				

REFERENCE DRAWINGS	NUMBER

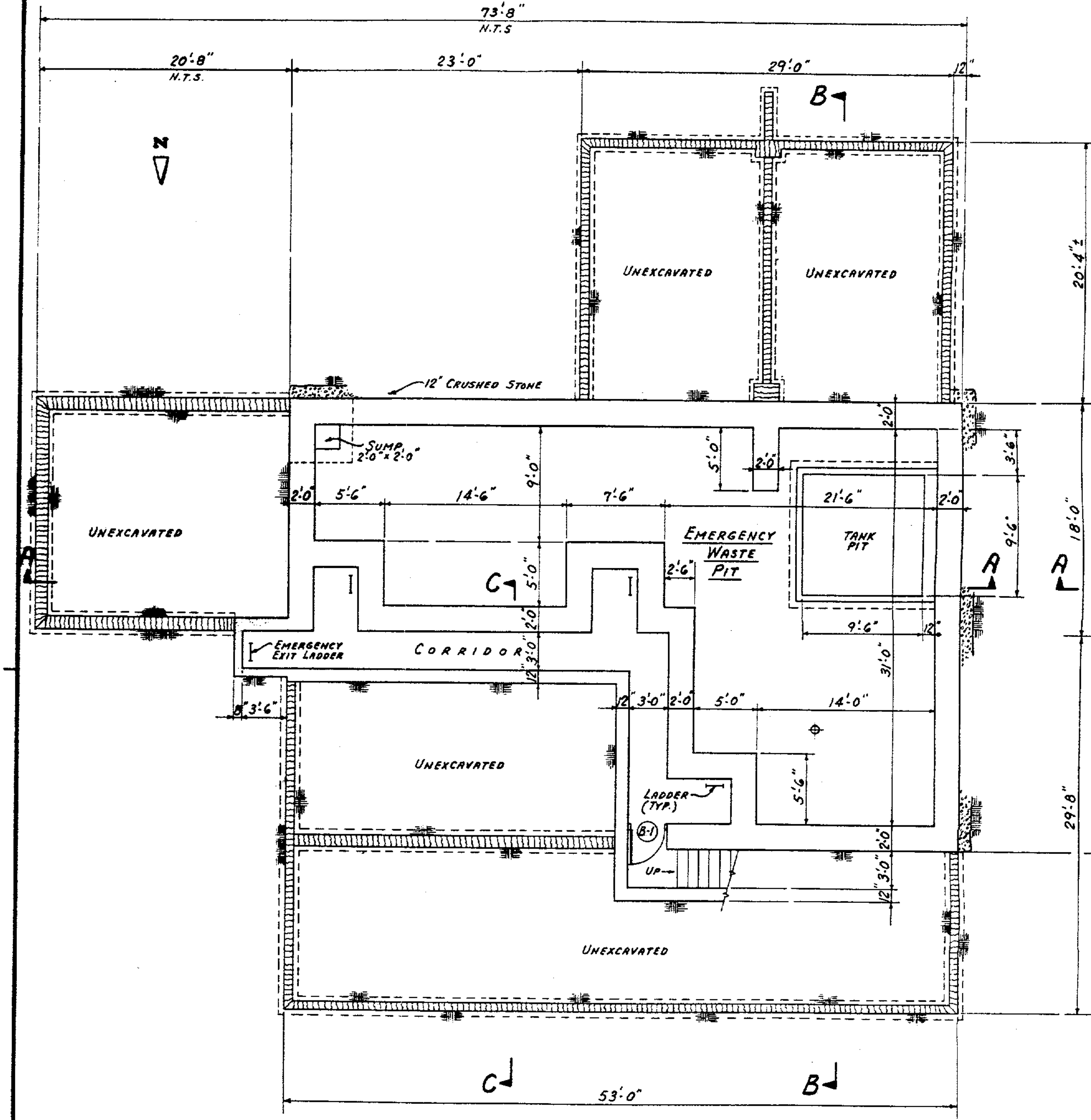
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

ILW MANAGEMENT FACILITY — BLDG. NO. 7825

SITE TOPOGRAPHY & SUBSURFACE DATA FOR CONCEPTUAL DESIGN

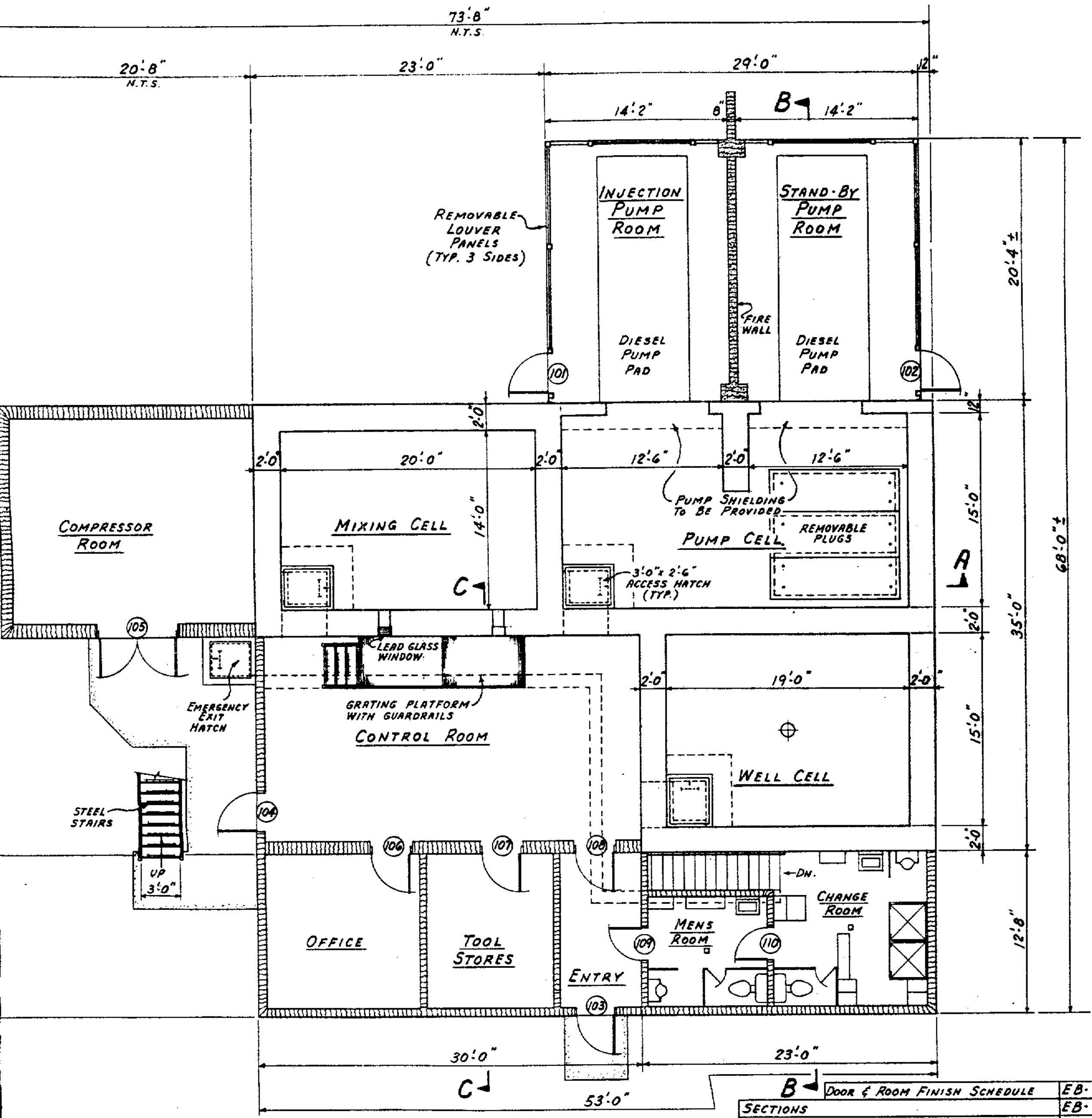
SUBMITTED: C.M. Carter 11-13-74 — ACCEPTED: R.C. Robinson 11/13/74 — APPROVED: B.W. Renfro

H.O. BAKER | X | 21247 | EA | 005 | E | REV.



BASEMENT PLAN

NO REPRESENTA
THAT THE USE
METHOD OR PRO
PRIVATE RIGHTS
THE USE OF, O
INFORMATION, A
DRAWINGS. THE
TO BIDDER AND
TO BE RETURNE



FIRST FLOOR PLAN

9 - 9 - 74
~~4 - 5 - 73~~

REFERENCE DRAWINGS	NUMBER
DOOR & ROOM FINISH SCHEDULE	EB-004-D
SECTIONS	EB-003-D
ROOF PLAN	EB-002-D

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

NEW HYDROFRACTURE CONCEPTUAL DESIGN — BLDG. NO. 7860

BASEMENT AND FIRST FLOOR PLANS

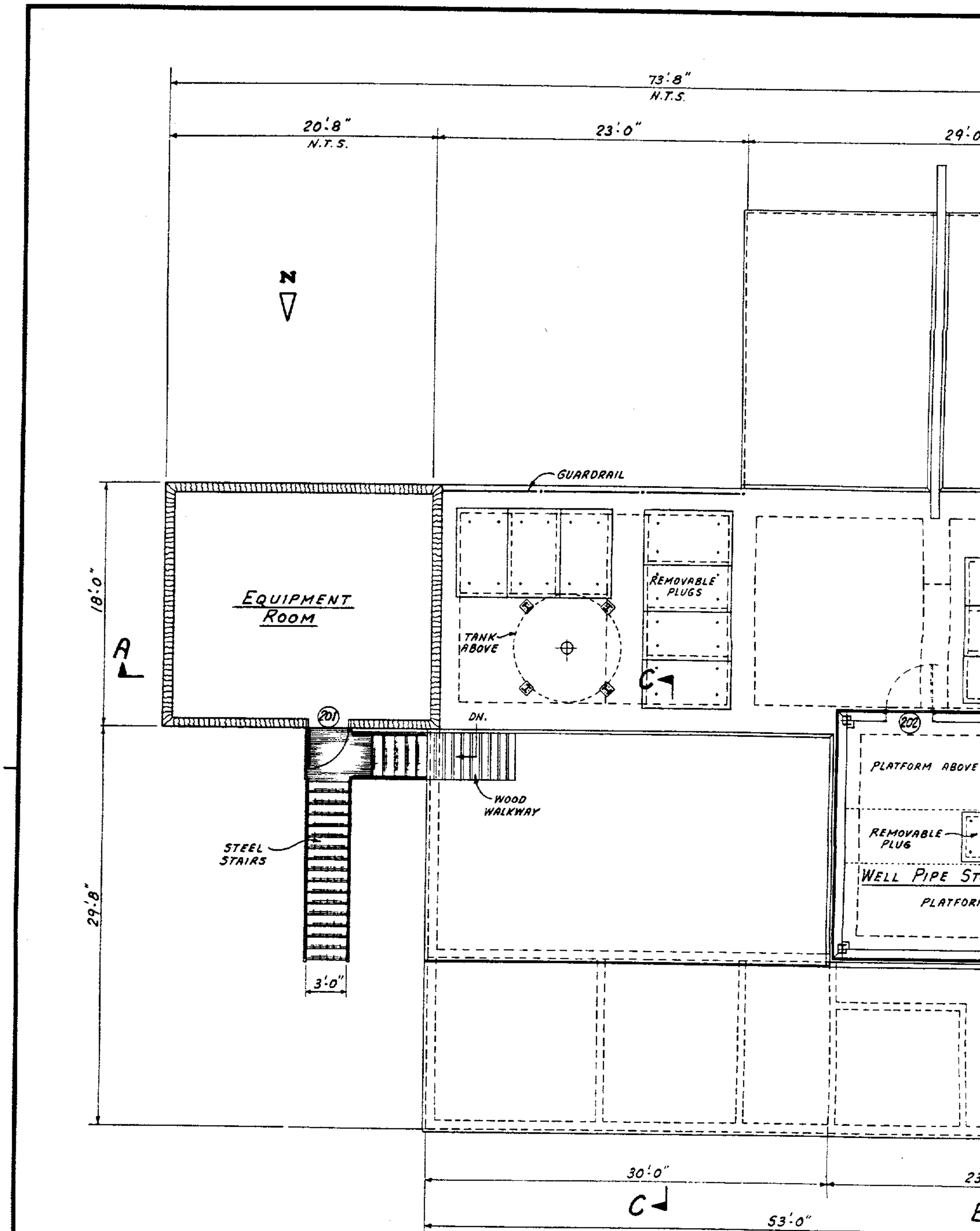
TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: 3/16" = 1'-0"

NO.	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
N.J. KIKER		R.E. Templeton	2-5-75		
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
				[signature]	2-4-75
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
				[signature]	2-10-75

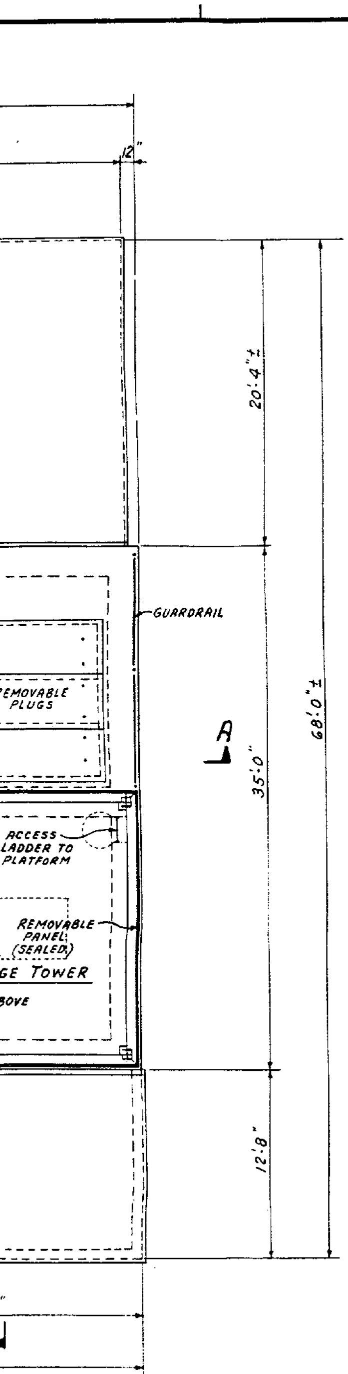
SUBMITTED: C.M. Carter — ACCEPTED: R.A. Robinson — APPROVED: E.W. Renfro

H.O. BAKER | X | 21255 | EB | 001 | D | REV.



73'8"
N.T.S.
20'8"
N.T.S.
23'0"
N
GUARDRAIL
EQUIPMENT ROOM
18'0"
A
REMOVABLE PLUGS
TANK ABOVE
C
201
202
DN.
WOOD WALKWAY
STEEL STAIRS
PLATFORM ABOVE
REMOVABLE PLUG
29'8"
3'0"
30'0"
C
53'0"

ROOF PLAN



9-9-74
~~4-5-73~~

REFERENCE DRAWINGS	NUMBER
DOOR & ROOM FINISH SCHEDULE	EB-004-D
SECTIONS	EB-003-D
BASEMENT & FIRST FLOOR PLANS	EB-001-D

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

NEW HYDROFRACTURE CONCEPTUAL DESIGN BLDG. NO. 7860

ROOF PLAN

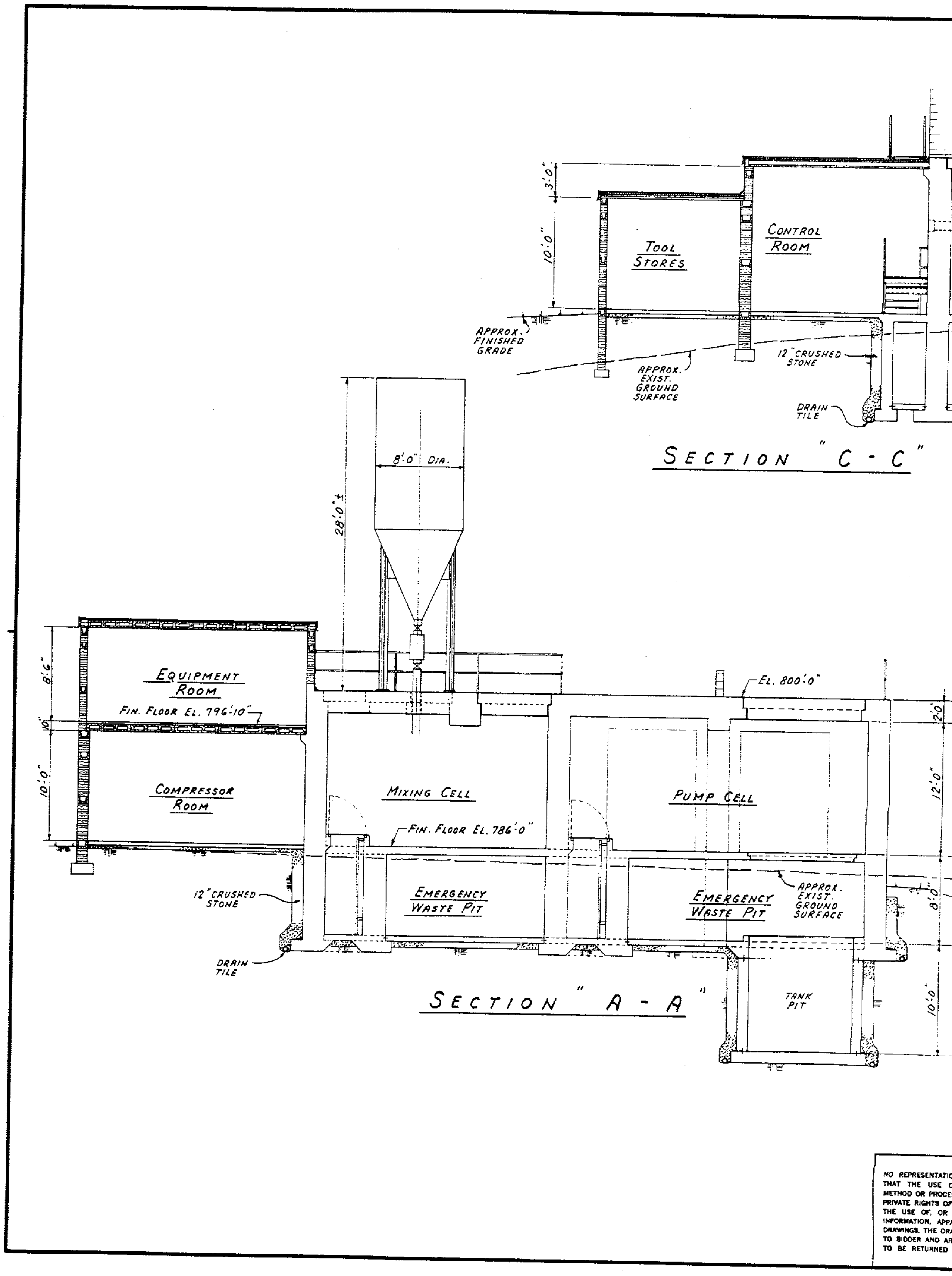
TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: $\frac{3}{16}$" = 1'-0"

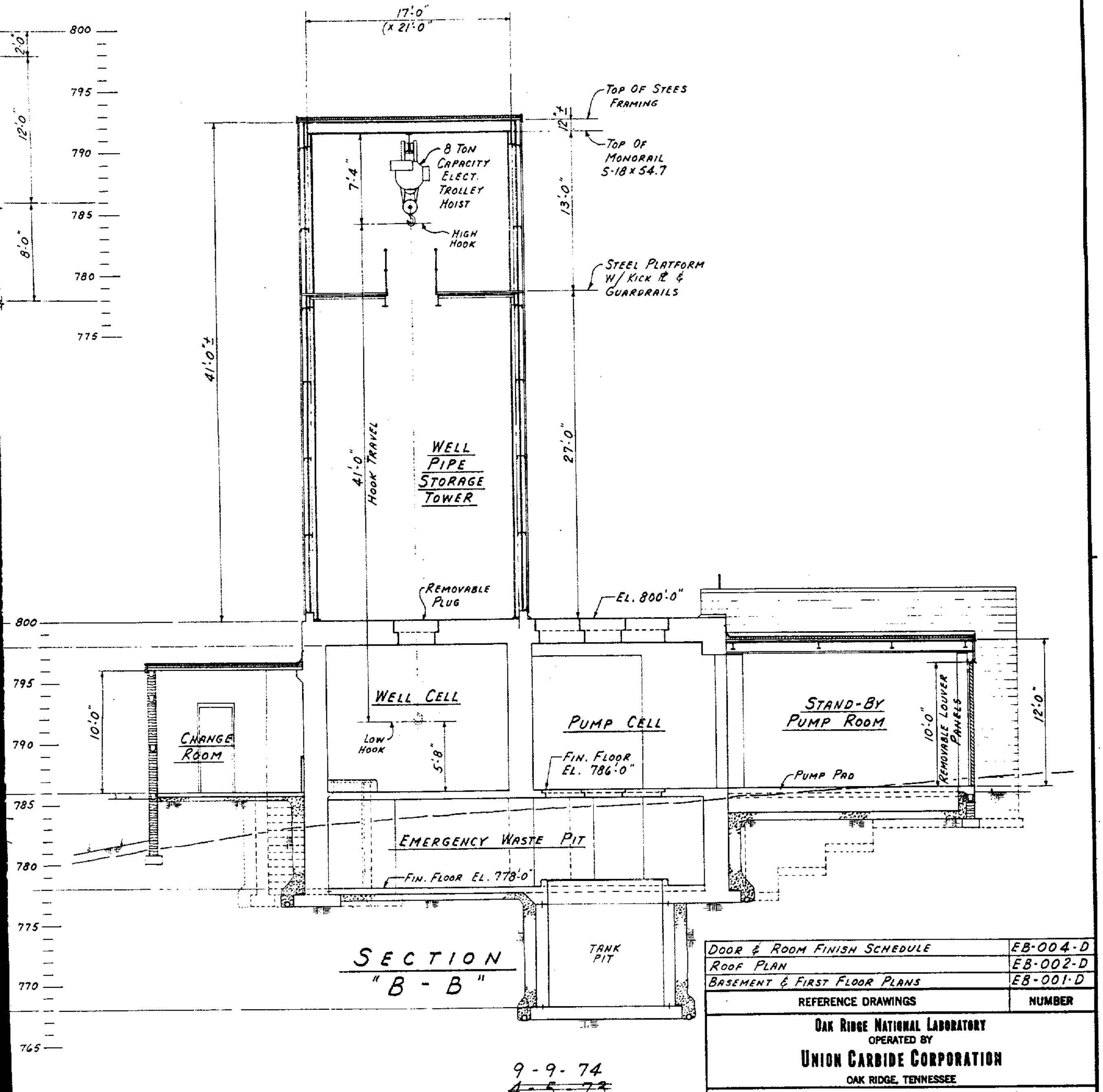
NO.	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
N.J. KIKER		R.E. Jamphr	2-5-75		
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
				LAEgert	2-5-75
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
					7-10-75

SUBMITTED	ACCEPTED	APPROVED
C. M. Carter	R.G. Robinson	G. W. Renfro

H. O. BAKER | X | 21255 | EB | 002 | D | REV.


TOOL STORES
CONTROL ROOM
3'-0"
10'-0"
APPROX. FINISHED GRADE
APPROX. EXIST. GROUND SURFACE
12" CRUSHED STONE
DRAIN TILE
SECTION "C - C"
8'-0" DIA.
28'-0"±
EQUIPMENT ROOM
FIN. FLOOR EL. 796'-10"
COMPRESSOR ROOM
8'-6"
10"
10'-0"
MIXING CELL
FIN. FLOOR EL. 786'-0"
EL. 800'-0"
PUMP CELL
2'-0"
12'-0"
8'-0"
10'-0"
EMERGENCY WASTE PIT
EMERGENCY WASTE PIT
APPROX. EXIST. GROUND SURFACE
TANK PIT
12" CRUSHED STONE
DRAIN TILE
SECTION "A - A"



Reference Drawings	Number
Door & Room Finish Schedule	EB-004-D
Roof Plan	EB-002-D
Basement & First Floor Plans	EB-001-D

Oak Ridge National Laboratory
Operated by
Union Carbide Corporation
Oak Ridge, Tennessee

New Hydrofracture Conceptual Design — Bldg. No. 7860

Sections

Tolerances unless otherwise specified:	
Fractions ±	
Decimals ±	
Angles ±	
Scale: 3/16" = 1'-0"	

No.	Revisions	Date	Appd	Appd

Drawn	Date	Submitted	Date	Approved	Date
N.J. Kiker		R.E. [signature]	2-5-75		
Designed	Date	Approved	Date	Approved	Date
				[signature]	2-4-75
Checked	Date	Approved	Date	Approved	Date
				[signature]	2-10-75

Submitted	Accepted	Approved
C.M. Carter	R.C. [signature]	G.W. [signature]

H.O. Baker	X	21255	EB	003	D	Rev.

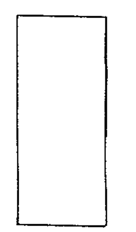
DOOR SCHEDULE						
DR NO.	SIZE	TYPE	MAT.	GLASS	HARDWARE LIST	HARDWARE CLOSER
			NOTE 1	NOTE 2	NOTE 3	
B-1	2870	A	HM		L-1	
101	3070	B	HM	CW	L-1	✓
102	3070	B	HM	CW	L-1	✓
103	3070	B	HM	CS	L-1	✓
104	3070	B	HM	CS	L-1	✓
105	6070	C	HM	CS	L-2	
106	3070	B	HM	CS	L-3	
107	3070	B	HM	CS	L-3	
108	3070	B	HM	CS	L-4	✓
109	2870	A	HM		L-4	✓
110	2870	A	HM		L-4	✓
201	3070	B	HM	CS	L-1	
*202	3470	B	HM	CW	L-1	✓

* WEATHERSTRIP

ROOM DESI
EMERGENCY
CORRIDOR
INJECTION P
STAND-BY PU
COMPRESSO
MIXING CE
PUMP CEL
CONTROL R
WELL CELL
OFFICE
TOOL STORE
ENTRY
MEN'S ROOM
CHANGE ROO
EQUIPMENT R
WELL PIPE RO

NOTES
1. DOORS
   HM - HOLLOW METAL
2. GLASS
   C.W. - CLEAR WIRE GLASS
   C.S. - CLEAR SHEET GLASS
3. HARDWARE
   L-1 - MORTISE LOCKSET
   L-2 - MORTISE LOCKSET
   HEAD & FOOT BOLTS
   L-3 LATCH SET
   L-4 PULL & PUSH PLATES

CYLINDER FOR LOCKSETS SHALL BE "BEST UNIVERSAL" LOCK CO. 1 5/32" DIAMETER BORE WITH 7 PIN CORE SET ON CODE 2 B 100 - NO SUBSTITUTE. PROVIDE TWO BLANK KEYS FOR EACH LOCK FURNISHED.

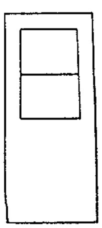


A

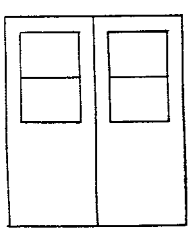
DC

ROOM FINISH SCHEDULE

...ION	STORY	CEILING HEIGHT	FLOORS	BASE	WALL	CEILING
...TE PIT	B	7'-4"	CONCRETE WITH HARDENER		CONCRETE	CONCRETE
	B	7'-4"	" " "		"	"
...P ROOM	1	12'	" " "		REMOVABLE PANELS & FIRE WALL-PAINTED	EXPOSED CONST.-PAINTED
... ROOM	1	12'	" " "		" " " " "	" " "
...ROOM	1	10'	" " "		CONC. & CONC. BLOCK	EXPOSED CONC. DECK
	1	12'	CONCRETE-AMERCOAT 66		CONCRETE-AMERCOAT 66	CONCRETE-AMERCOAT 66
	1	12'	" " "		" " "	" " "
...M	1	13'	VINYL ASBESTOS TILE	VINYL COVE	CONC. & CONC. BLOCK-PAINTED	CONCRETE DECK-PAINTED
	1	12'	CONCRETE-AMERCOAT 66		CONCRETE-AMERCOAT 66	CONCRETE-AMERCOAT 66
	1	10'	VINYL ASBESTOS TILE	VINYL COVE	CONC. BLOCK-PAINTED	CONCRETE DECK-PAINTED
	1	10'	" " "	" "	" " "	" " "
	1	10'	" " "	" "	" " "	" " "
	1	10'	" " "	" "	" " "	" " "
	1	10'	" " "	" "	CONC. & CONC. BLOCK-PAINTED	" " "
...OM	2	8'-6"	CONCRETE WITH HARDENER		CONC. & CONC. BLOCK-PAINTED	EXPOSED CONC. DECK
...M	2	41'	CONCRETE-AMERCOAT 66		EXPOSED SIDING-PAINTED-STEEL	EXPOSED CONST.-PAINTED



B



C

...OR TYPES

9-9-74

REFERENCE DRAWINGS	NUMBER
SECTIONS	EB-003-D
ROOF PLAN	EB-002-D
BASEMENT & FIRST FLOOR PLAN	EB-001-D

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

NEW HYDROFRACTURE CONCEPTUAL DESIGN BLDG. NO. 7860

DOOR & ROOM FINISH SCHEDULE

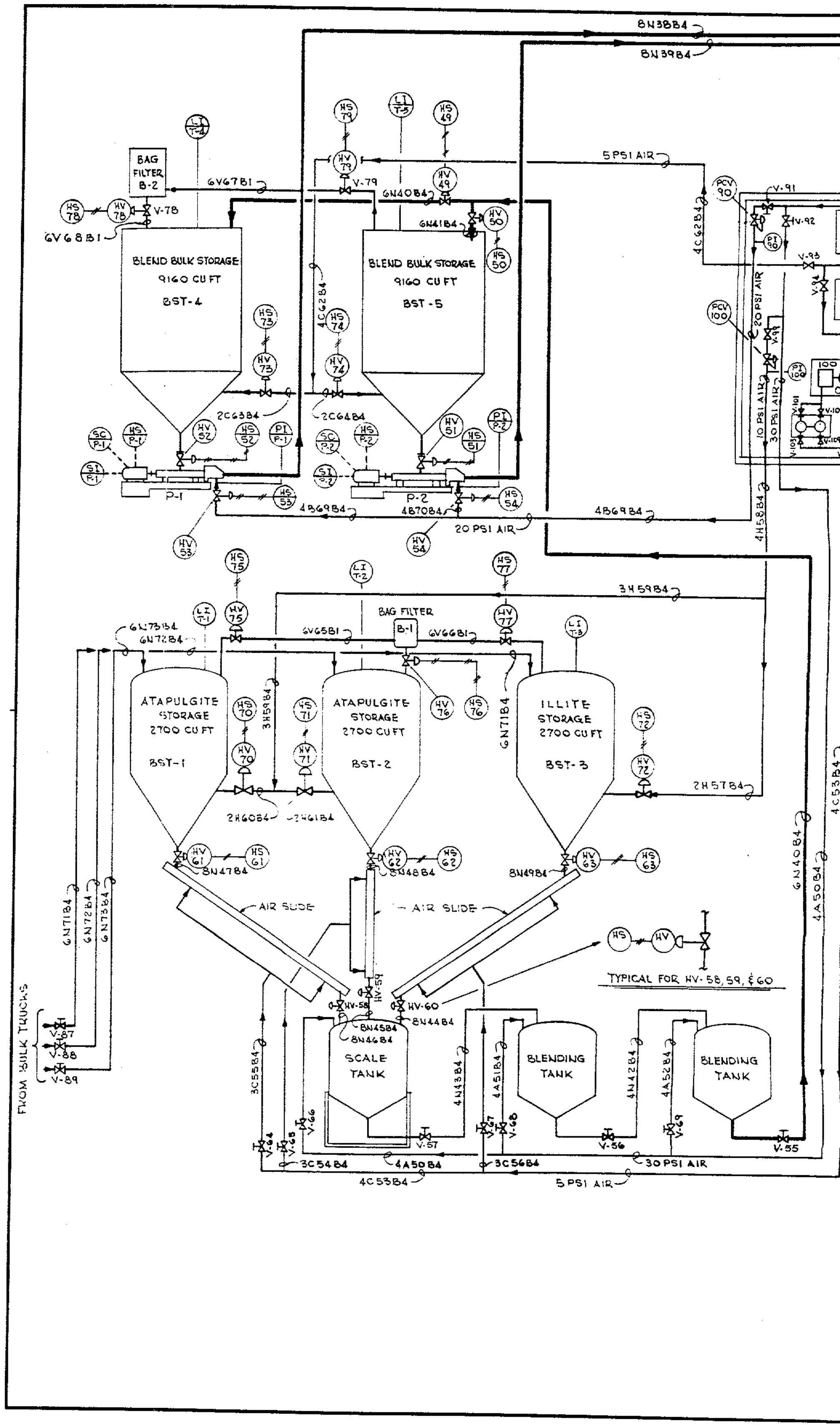
TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: NONE

NO.	REVISIONS	DATE	APPD	APPD

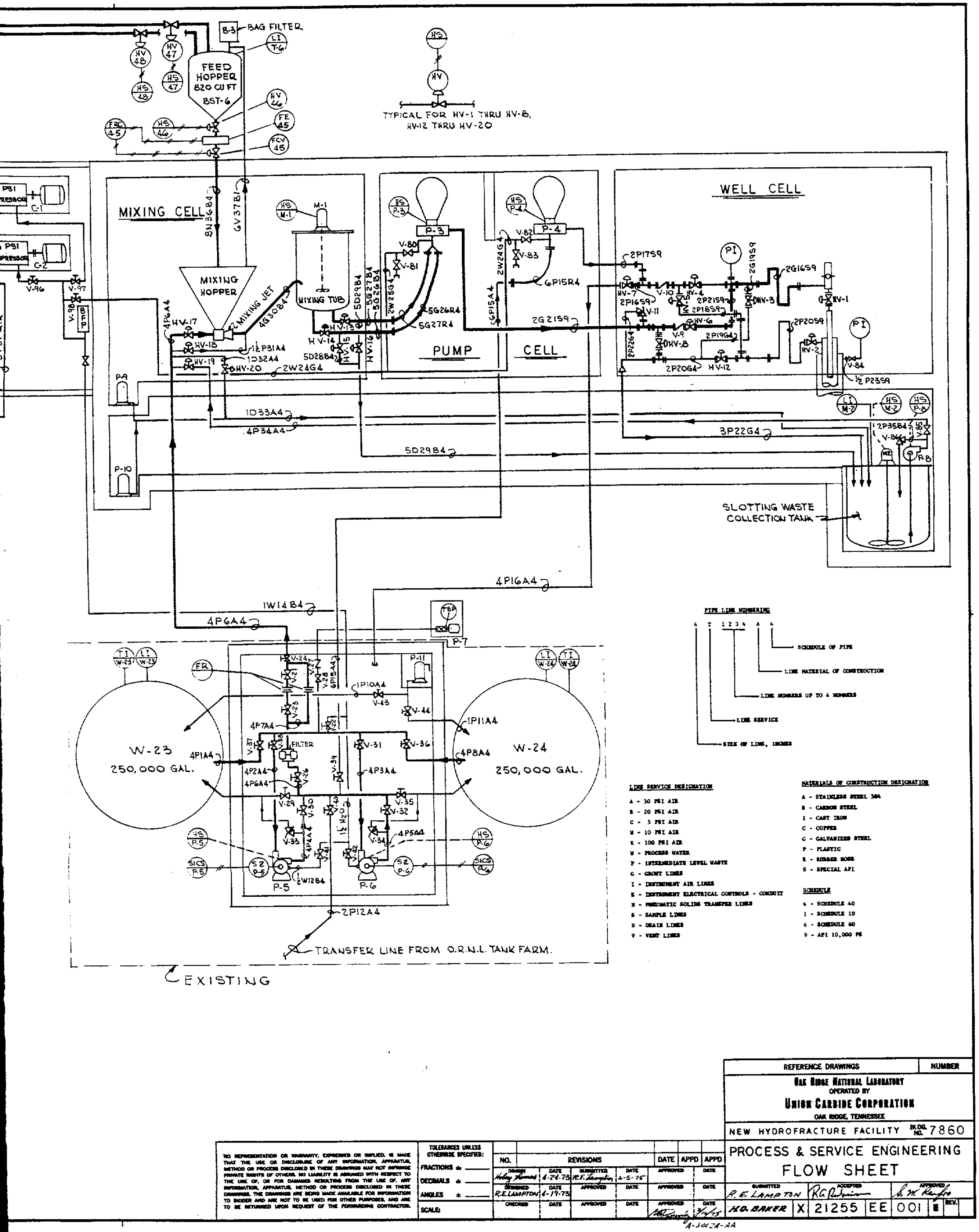
DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
LEWIS	9-6-74	R.E. Langston	2-5-75		
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
				L.A. Lockert	2-4-75
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
				[illegible]	2-10-75

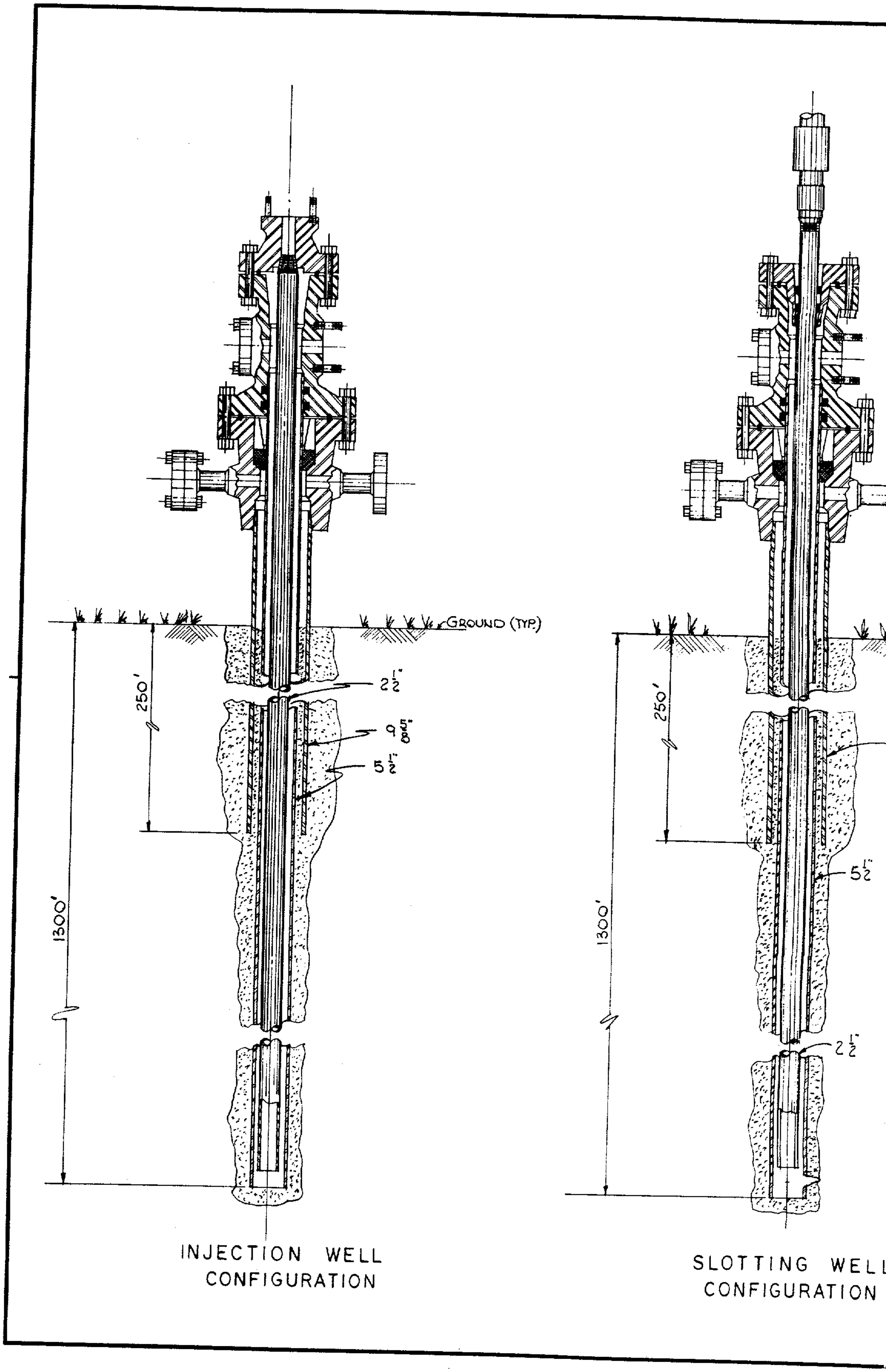
SUBMITTED	ACCEPTED	APPROVED
C. M. Carter	R. G. Robinson	[illegible]

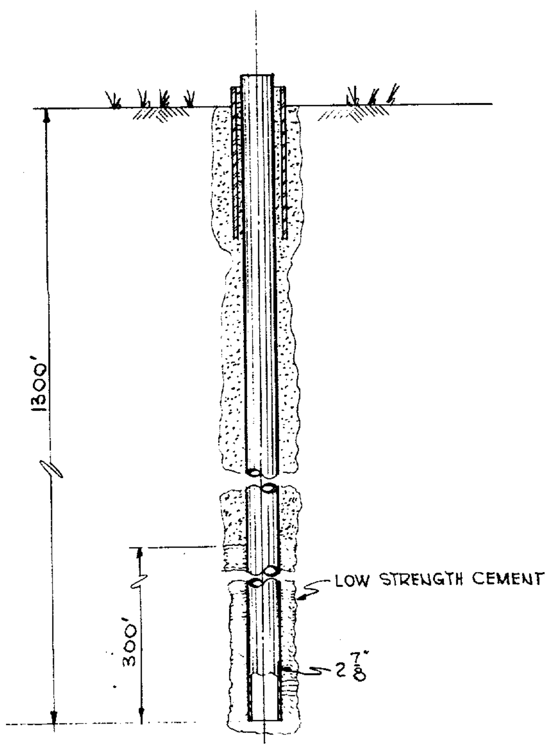
H.O. BAKER | X | 21255 | EB | 004 | D | REV.



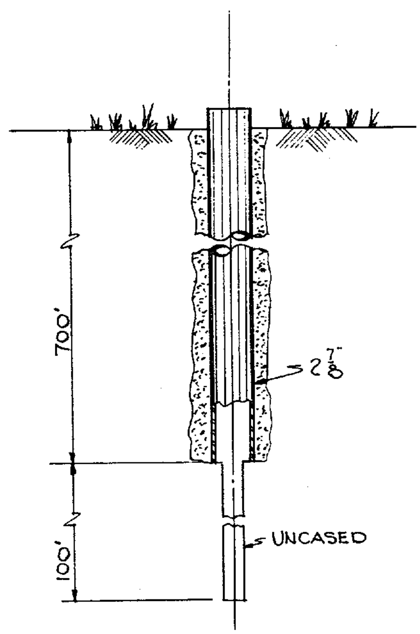
BAG FILTER B-2
BLEND BULK STORAGE
9160 CU FT
BST-4
BLEND BULK STORAGE
9160 CU FT
BST-5
P-1
P-2
5 PSI AIR
20 PSI AIR
BAG FILTER
B-1
ATAPULGITE STORAGE
2700 CU FT
BST-1
ATAPULGITE STORAGE
2700 CU FT
BST-2
ILLITE STORAGE
2700 CU FT
BST-3
AIR SLIDE
AIR SLIDE
TYPICAL FOR HV-58, 59, & 60
SCALE TANK
BLENDING TANK
BLENDING TANK
30 PSI AIR
5 PSI AIR
FROM BULK TRUCKS


BAG FILTER
FEED HOPPER 820 CU FT BST-6
TYPICAL FOR HV-1 THRU HV-8, HV-12 THRU HV-20
MIXING CELL
MIXING HOPPER
MIXING JET
MIXING TUB
PUMP
CELL
WELL CELL
SLOTTING WASTE COLLECTION TANK
W-23 250,000 GAL.
W-24 250,000 GAL.
FILTER
P-5
P-6
TRANSFER LINE FROM O.R.N.L. TANK FARM.
EXISTING
PIPE LINE NUMBERING
4 T 1234 A 4
SCHEDULE OF PIPE
LINE MATERIAL OF CONSTRUCTION
LINE NUMBERS UP TO 4 NUMBERS
LINE SERVICE
SIZE OF LINE, INCHES
LINE SERVICE DESIGNATION
A - 30 PSI AIR
B - 20 PSI AIR
C - 5 PSI AIR
H - 10 PSI AIR
K - 100 PSI AIR
W - PROCESS WATER
P - INTERMEDIATE LEVEL WASTE
G - GROUT LINES
I - INSTRUMENT AIR LINES
E - INSTRUMENT ELECTRICAL CONTROLS - CONDUIT
N - PNEUMATIC SOLIDS TRANSFER LINES
S - SAMPLE LINES
D - DRAIN LINES
V - VENT LINES
MATERIALS OF CONSTRUCTION DESIGNATION
A - STAINLESS STEEL 304
B - CARBON STEEL
I - CAST IRON
C - COPPER
G - GALVANIZED STEEL
P - PLASTIC
R - RUBBER HOSE
S - SPECIAL API
SCHEDULE
4 - SCHEDULE 40
1 - SCHEDULE 10
6 - SCHEDULE 60
9 - API 10,000 PS
REFERENCE DRAWINGS
NUMBER
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE
NEW HYDROFRACTURE FACILITY BLDG. NO. 7860
PROCESS & SERVICE ENGINEERING
FLOW SHEET
R. E. LAMPTON
H.O. BAKER
X 21255 EE 001 E
A-30124-AA


GROUND (TYP)
250'
1300'
$2\frac{1}{2}$"
$9\frac{5}{8}$"
$5\frac{1}{2}$"
INJECTION WELL
CONFIGURATION
250'
1300'
$5\frac{1}{2}$"
$2\frac{1}{2}$"
SLOTTING WELL
CONFIGURATION



GAMMA MONITORING WELL



ROCK COVER WELL

REFERENCE DRAWINGS	NUMBER

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

NEW HYDROFRACTURE FACILITY — BLDG. NO.

CONCEPTUAL DESIGN

INJECTION AND MONITORING WELL CONFIGURATION

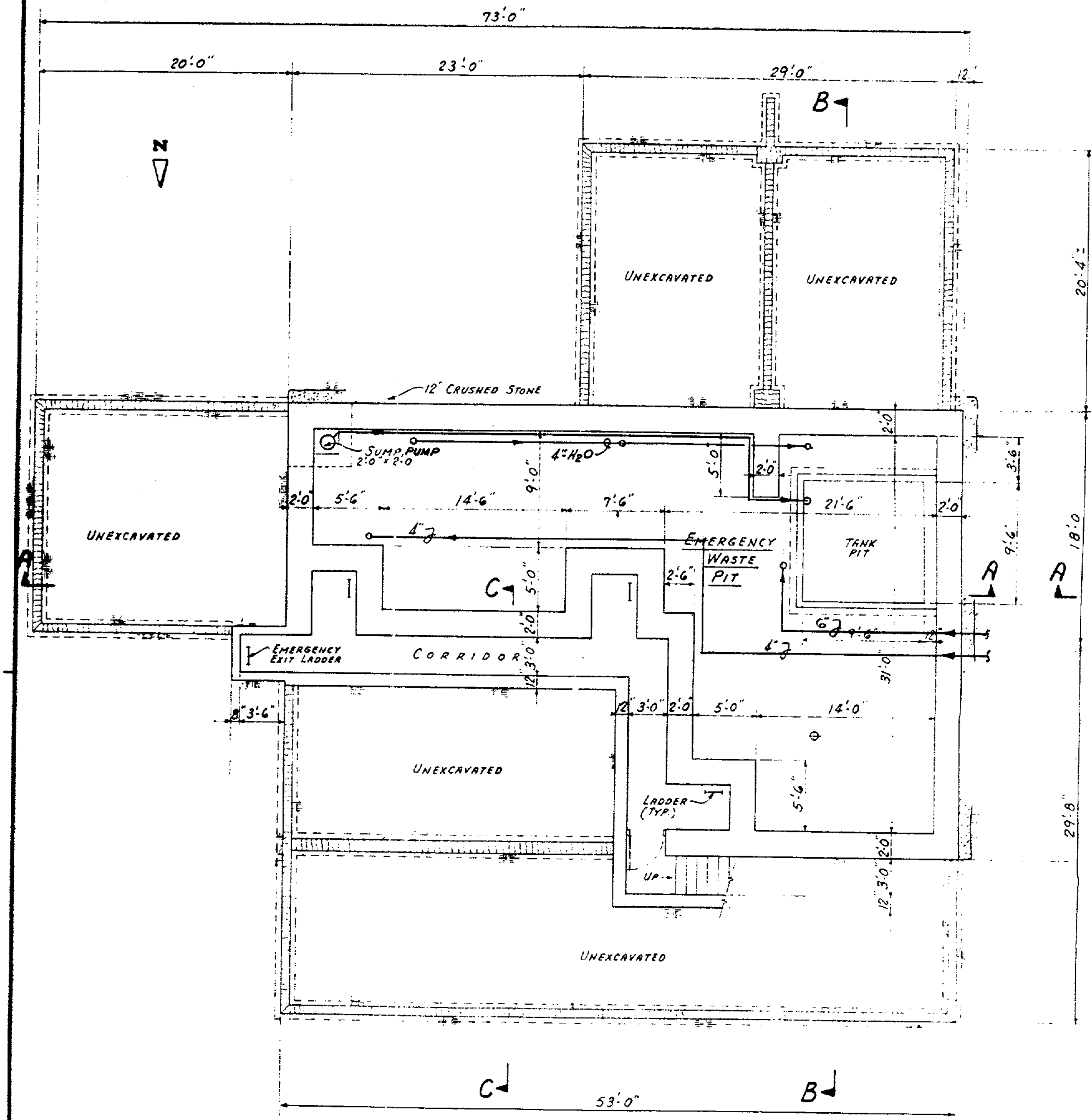
TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: NONE

NO.	REVISIONS	DATE	APPD	APPD

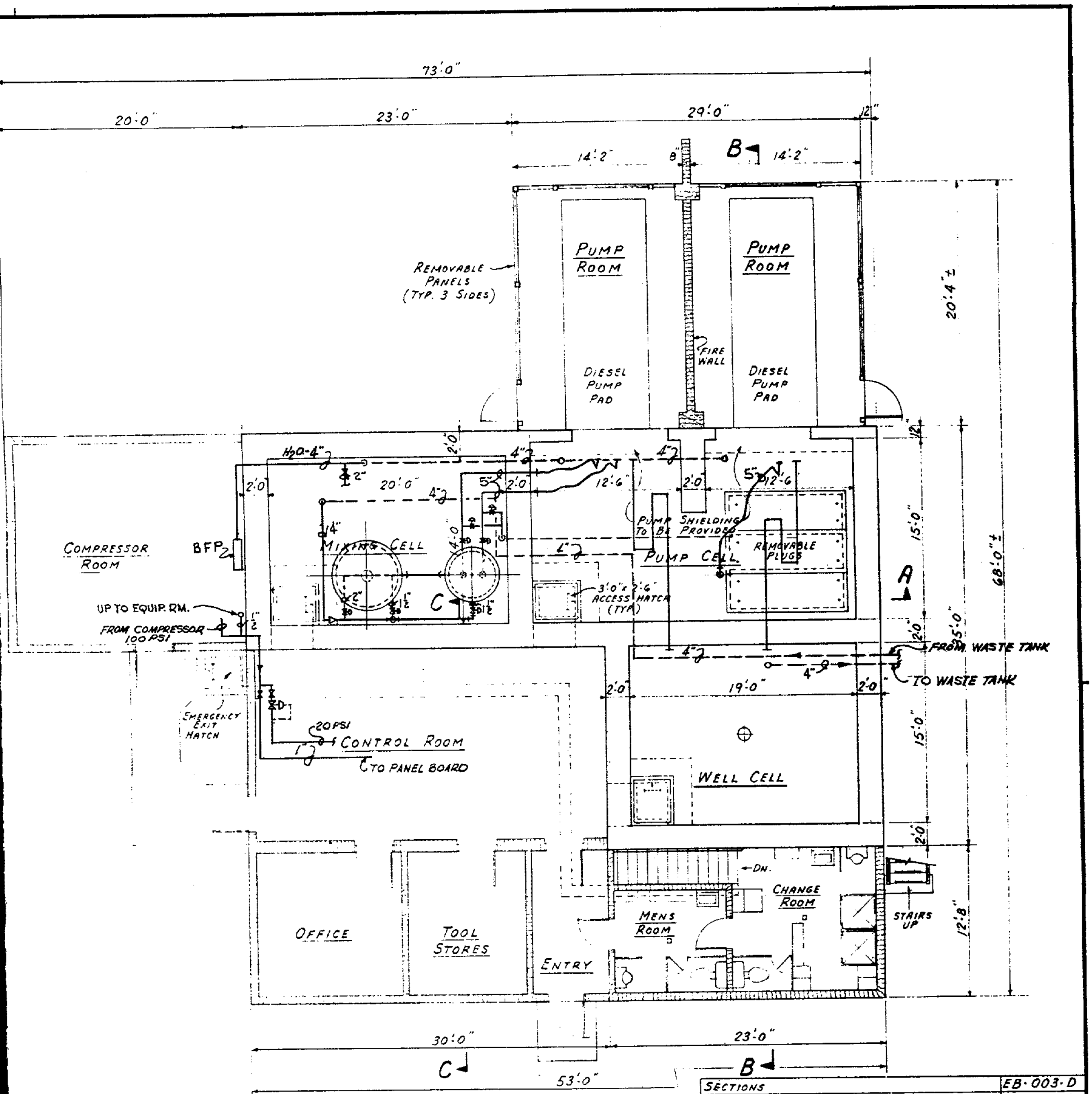
DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
Holley Thomas	6-26-73	R. E. Lampton	2-5-75		
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
					7/7/75

SUBMITTED	ACCEPTED	APPROVED
R.E. LAMPTON		

H.O. BAKER | X | 21255 | EE | 002 | D | REV.



BASEMENT PLAN



FIRST FLOOR PLAN

SECTIONS	EB-003-D
ROOF PLAN	EB-002-D
REFERENCE DRAWINGS	NUMBER

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

NEW HYDROFRACTURE CONCEPTUAL DESIGN — BLDG. NO. 7860

CELL PROCESS & SERVICE PIPING PLANS

...N OR WARRANTY, EXPRESSED OR IMPLIED, IS MADE ...R DISCLOSURE OF ANY INFORMATION, APPARATUS, ...S DISCLOSED IN THESE DRAWINGS MAY NOT INFRINGE ...OTHERS. NO LIABILITY IS ASSUMED WITH RESPECT TO ...FOR DAMAGES RESULTING FROM THE USE OF, ANY ...ATUS, METHOD OR PROCESS DISCLOSED IN THESE ...INGS ARE BEING MADE AVAILABLE FOR INFORMATION ...NOT TO BE USED FOR OTHER PURPOSES, AND ARE ...PON REQUEST OF THE FORWARDING CONTRACTOR.

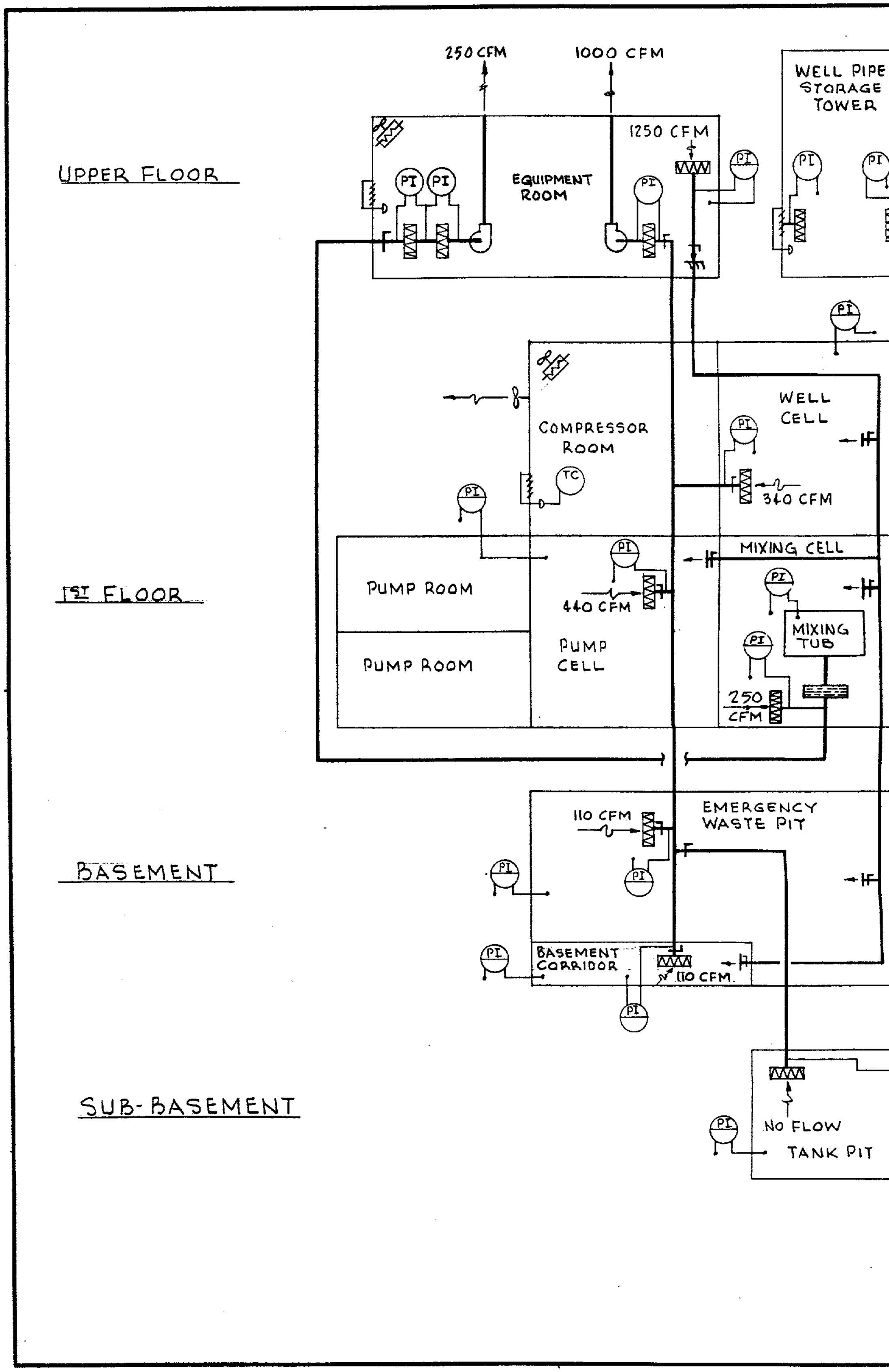
TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: 3/16" = 1'-0"

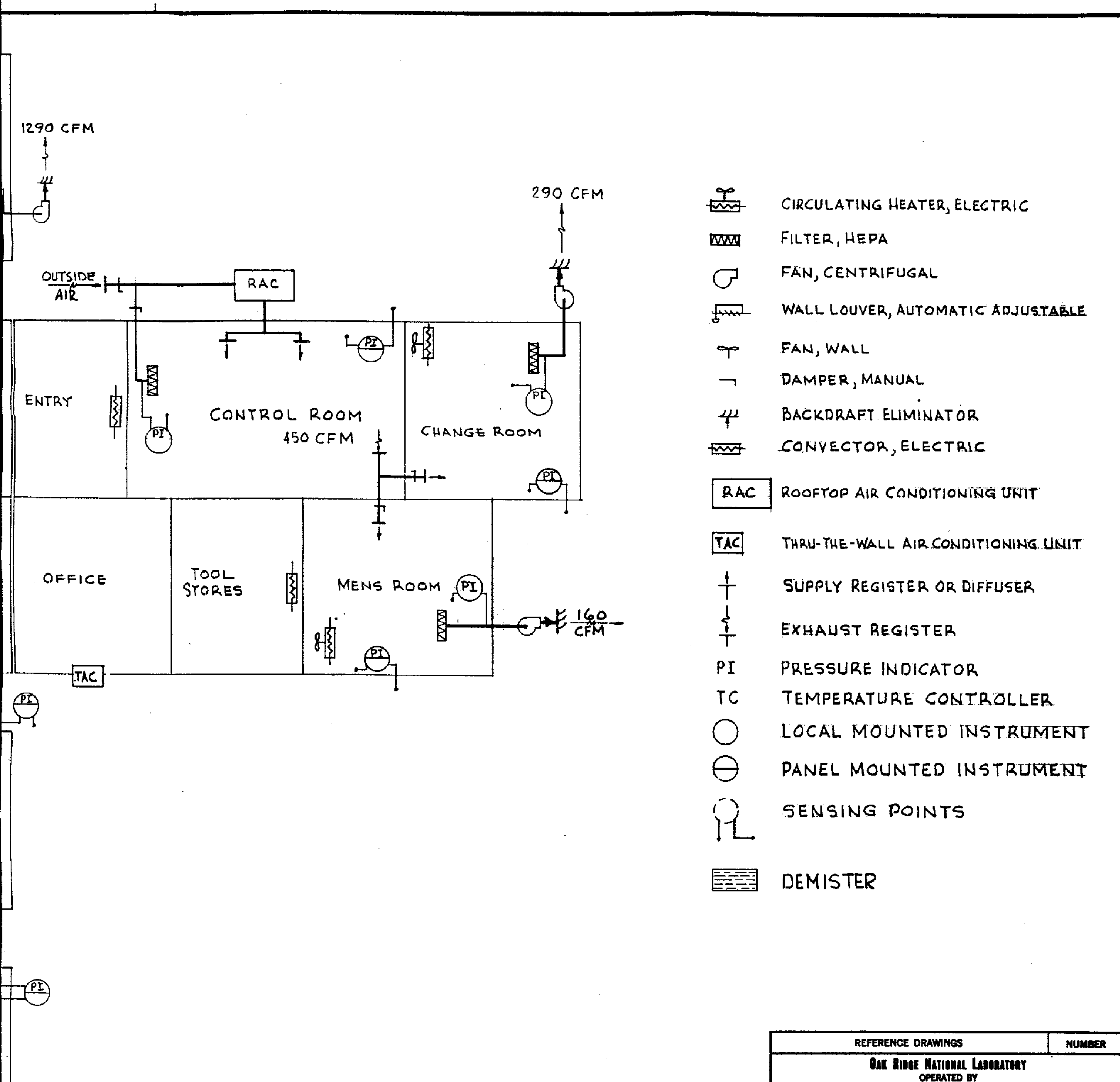
NO.	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
Hobey Thomas	4-9-73	R.E. Lampton	2-5-75		
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
					2/14/75

SUBMITTED	ACCEPTED	APPROVED
R.E. LAMPTON	R.G. Robinson	G.W. Renfro

H. O. BAKER X 21255 EE 003 D REV.


250 CFM
1000 CFM
WELL PIPE STORAGE TOWER
1250 CFM
UPPER FLOOR
PI
EQUIPMENT ROOM
WELL CELL
COMPRESSOR ROOM
TC
340 CFM
MIXING CELL
PUMP ROOM
1ST FLOOR
440 CFM
MIXING TUB
PUMP ROOM
PUMP CELL
250 CFM
110 CFM
EMERGENCY WASTE PIT
BASEMENT
BASEMENT CORRIDOR
110 CFM.
SUB-BASEMENT
NO FLOW
TANK PIT



REFERENCE DRAWINGS	NUMBER

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

NEW HYDROFRACTURE FACILITY BLDG. NO. 7860

AIR HANDLING SCHEMATIC

TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE:

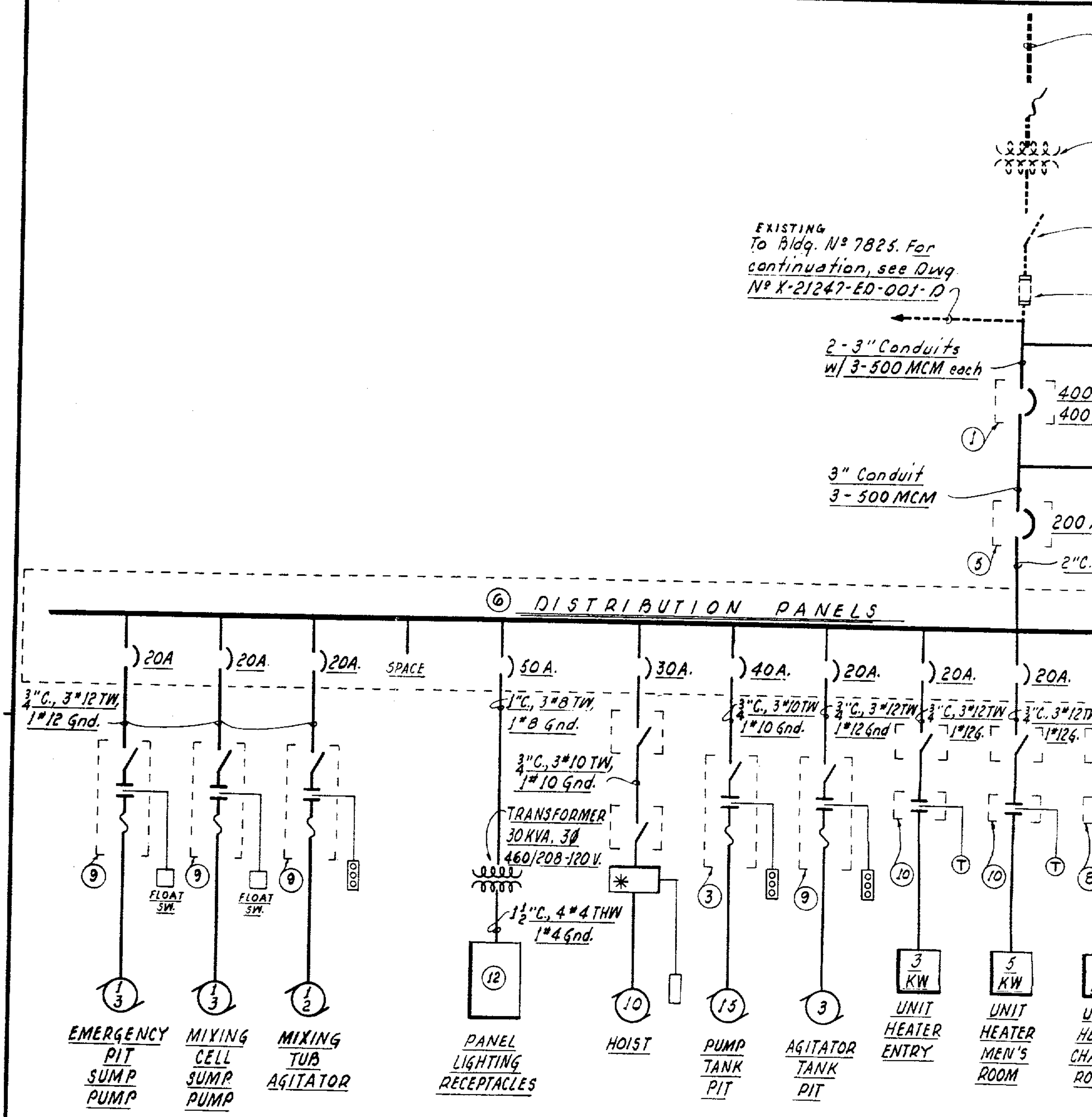
NO.	REVISIONS	DATE	APPD	APPD

DRAWN CLAPP	DATE	SUBMITTED R.E. Lampton	DATE 2-5-75	APPROVED	DATE
DESIGNED KAHN/HAMBY	DATE	APPROVED R.E. Phillips	DATE 9/6/74	APPROVED	DATE
CHECKED D.E. Kahn	DATE 5-29-73	APPROVED	DATE	APPROVED	DATE 7/1/75

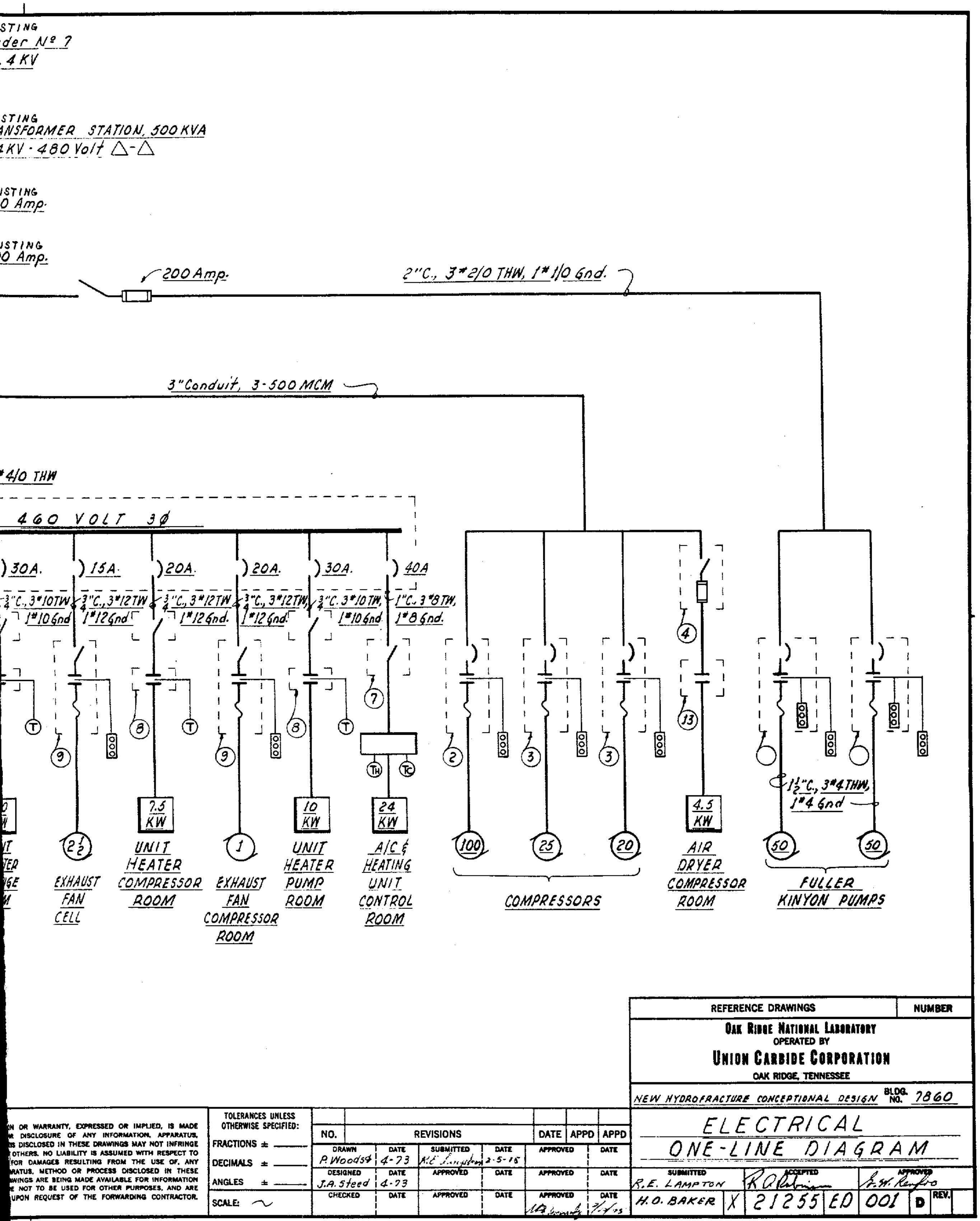
R.S. HAMBY 8/26/74

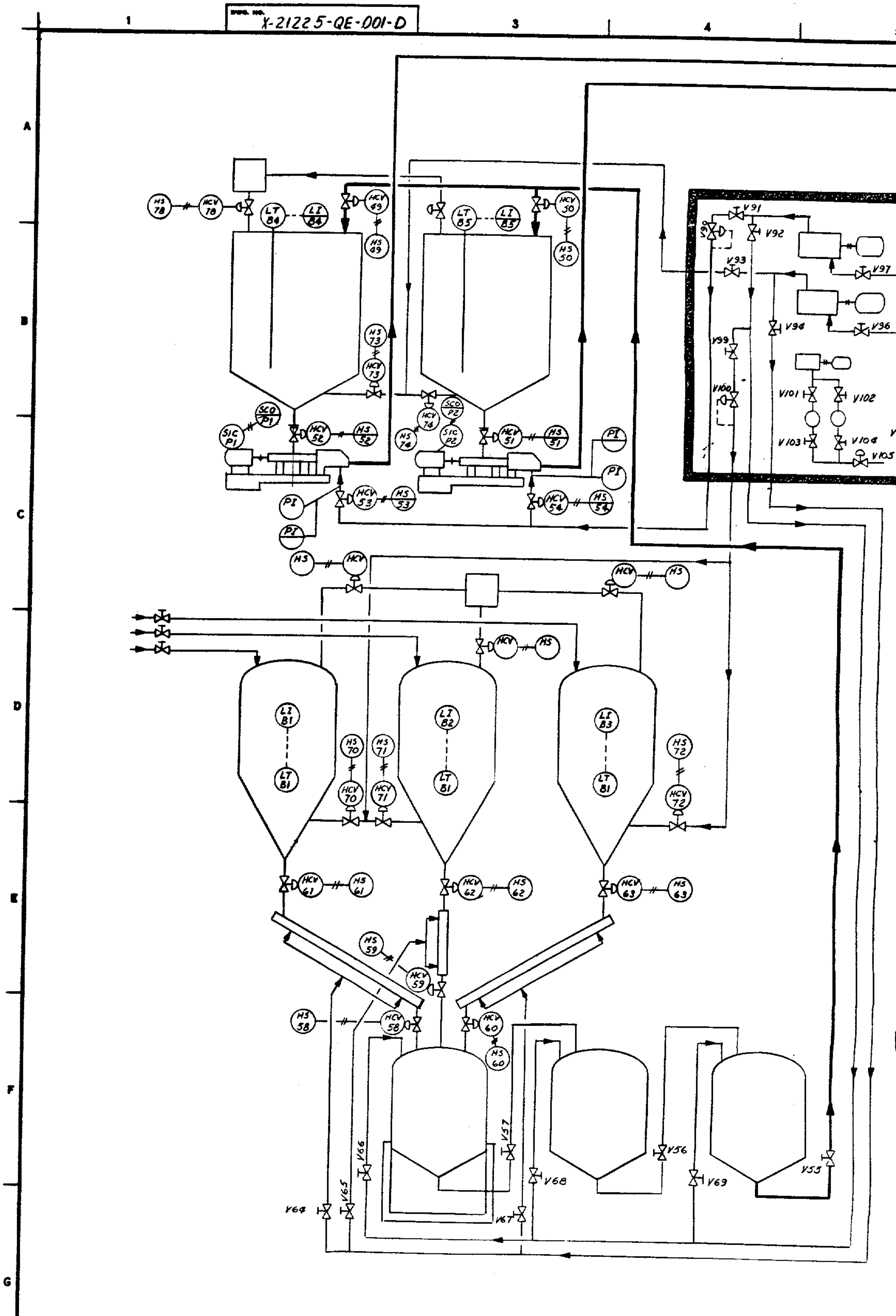
SUBMITTED	ACCEPTED	APPROVED
E.E. Choat	R.G. Robinson	G.W. Renfro

H.O. BAKER	X	21255	EG	001	D



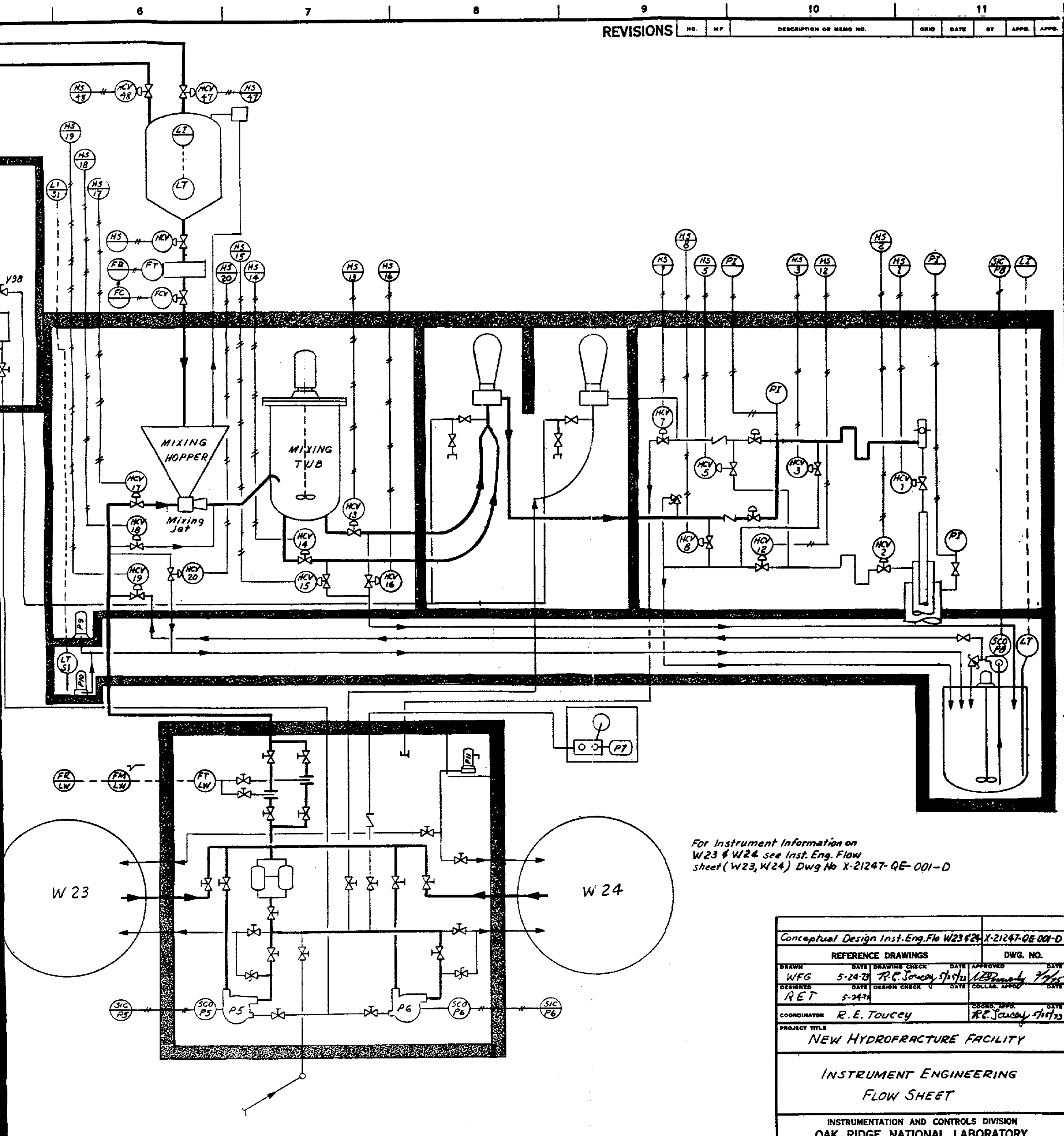
* Controls purchased with equipment


STING
der Nº 7
.4 KV
STING
ANSFORMER STATION, 500 KVA
KV - 480 Volt △-△
ISTING
0 Amp.
ISTING
0 Amp.
200 Amp.
2"C., 3#2/0 THW, 1#1/0 Gnd.
3"Conduit, 3-500 MCM
#4/0 THW
460 VOLT 3Ø
30A.
15A.
20A.
20A.
30A.
40A
¾"C., 3#10TW, 1#10Gnd
¾"C., 3#12TW, 1#12Gnd
¾"C., 3#12TW, 1#12Gnd.
¾"C., 3#12TW, 1#12Gnd
¾"C. 3#10TW, 1#10Gnd
1"C. 3#8TW, 1#8Gnd.
1½"C., 3#4THW, 1#4Gnd
7.5 KW
10 KW
24 KW
4.5 KW
EXHAUST FAN CELL
UNIT HEATER COMPRESSOR ROOM
EXHAUST FAN COMPRESSOR ROOM
UNIT HEATER PUMP ROOM
A/C & HEATING UNIT CONTROL ROOM
COMPRESSORS
AIR DRYER COMPRESSOR ROOM
FULLER KINYON PUMPS
REFERENCE DRAWINGS
NUMBER
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE
NEW HYDROFRACTURE CONCEPTIONAL DESIGN
BLDG. NO. 7860
ELECTRICAL
ONE-LINE DIAGRAM
TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: ~
NO.
REVISIONS
DATE
APPD
APPD
DRAWN P. Woods
DATE 4-73
DESIGNED J.A. Steed
DATE 4-73
CHECKED
SUBMITTED R.E. LAMPTON
H.O. BAKER
21255
ED
001
D
REV.



NO.	MF	DESCRIPTION OR MEMO NO.	GRID	DATE	BY	APPD.	APPD.
1		Dwg. no. was X-21255		9-17-74	WFG	[illegible]	

REVISIONS



For Instrument Information on W23 & W24 see Inst. Eng. Flow sheet (W23, W24) Dwg No X-21247-QE-001-D

REFERENCE DRAWINGS	DWG. NO.
Conceptual Design Inst. Eng. Flo W23 & 24	X-21247-QE-001-D

DRAWN: WFG, DATE 5-24-73 | DRAWING CHECK: R.E. Toucey 5/25/73 | APPROVED: [signature] 7/?/73

DESIGNED: RET, DATE 5-24-73 | DESIGN CHECK | COLLAB. APPD.

COORDINATOR: R.E. Toucey | COORD. APPD.: R.E. Toucey 5/25/73

PROJECT TITLE: NEW HYDROFRACTURE FACILITY

INSTRUMENT ENGINEERING FLOW SHEET

INSTRUMENTATION AND CONTROLS DIVISION
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORP.

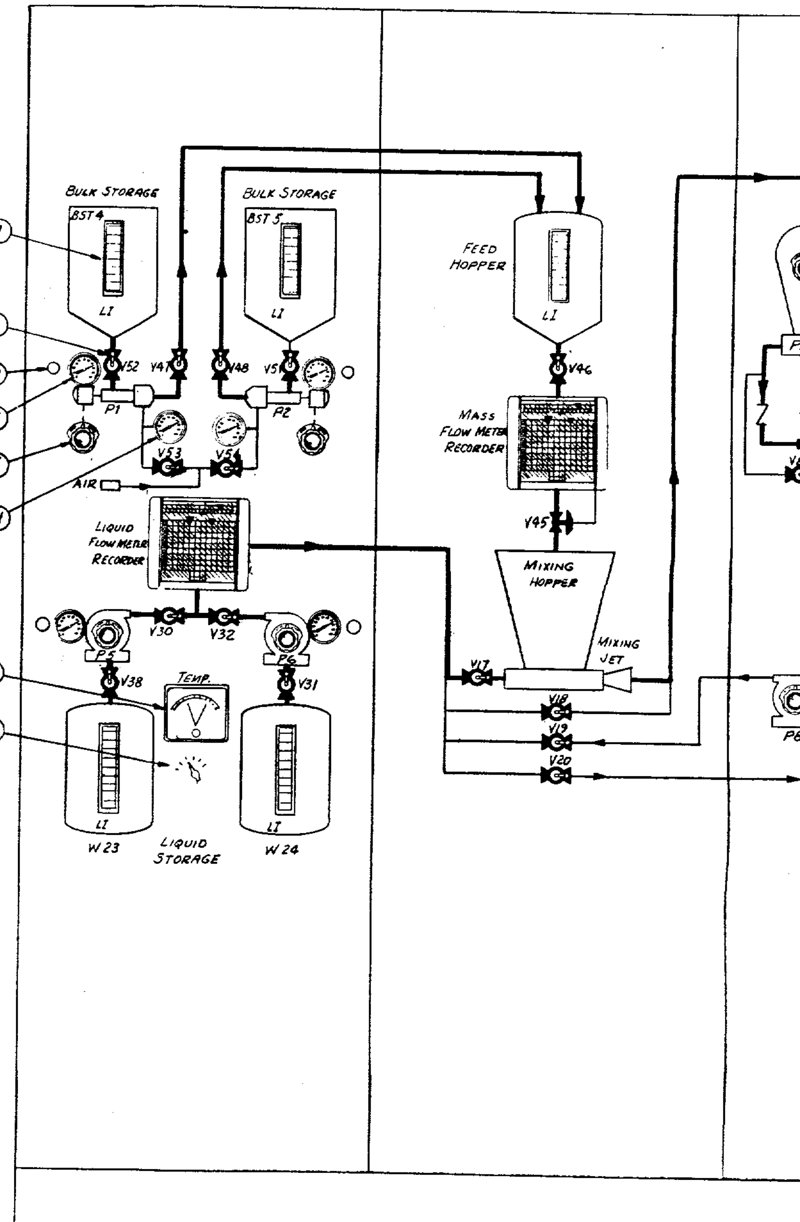
LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± 1/64
DECIMALS: ± .005
ANGLES: ± 0° 30'
SCALE:

APPROVED: B.C. Duggins 8/73 | APPROVED: K.G. Rahman | APPROVED: [signature]

PROJECT APPROVAL: H.O. BAKER | DRAWING NO. X-21225-QE-001-D-1

FILMED

DWG. NO.



NO.	NF	DESCRIPTION OR MEMO NO.	GRID	DATE	BY	APPD.	APPD.

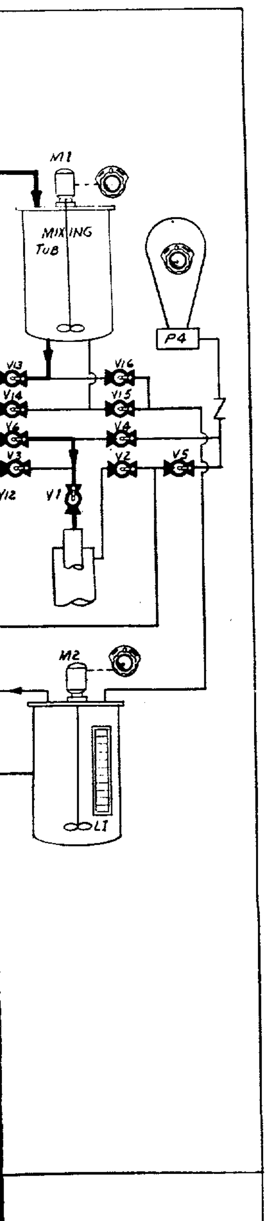
REVISIONS

REVISIONS

NO.	MF	DESCRIPTION OR MEMO NO.	GRID	DATE	BY	APPD.	APPD.

EQUIPMENT LIST

ITEM	REQ	DESCRIPTION
A	6	LEVEL INDICATING GAUGE
B	27	TOGGLE SWITCH FOR REMOTELY OPERATED VALVES
C	4	SPEED INDICATING GAUGES
D	4	SPEED CONTROL REGULATOR
E	9	START-STOP SWITCHES
F	1	TEMPERATURE INDICATOR
G	1	SELECTOR SWITCH
H	2	PRESSURE GAUGES



REFERENCE DRAWINGS	DWG. NO.
INSTRUMENT ENGINEERING FLOW SHEET	X-21225-QE-001-D

DRAWN WFG 8-17-73 · DRAWING CHECK R.E.T 8/17/73
DESIGNED R Toucey 8/73 · DESIGN CHECK R.E.T. 8/17/73
COORDINATOR R.E. TOUCEY

PROJECT TITLE
NEW HYDROFRACTURE FACILITY

INSTRUMENT CONTROL PANEL
FRONT PANEL LAYOUT
EQUIPMENT LIST

INSTRUMENTATION AND CONTROLS DIVISION
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORP.

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± 1/64
DECIMALS: ± .005
ANGLES: ± 0° 30'
SCALE:

APPROVED 11/73 · APPROVED R.G. Robinson · APPROVED 11/73
PROJECT APPROVAL H. O. BAKER
DRAWING NO. X-21225-QE-002-D-0

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